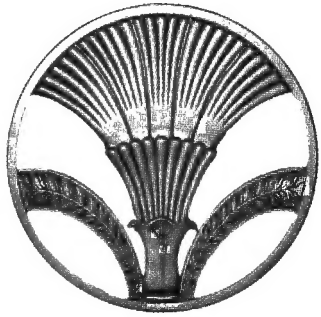
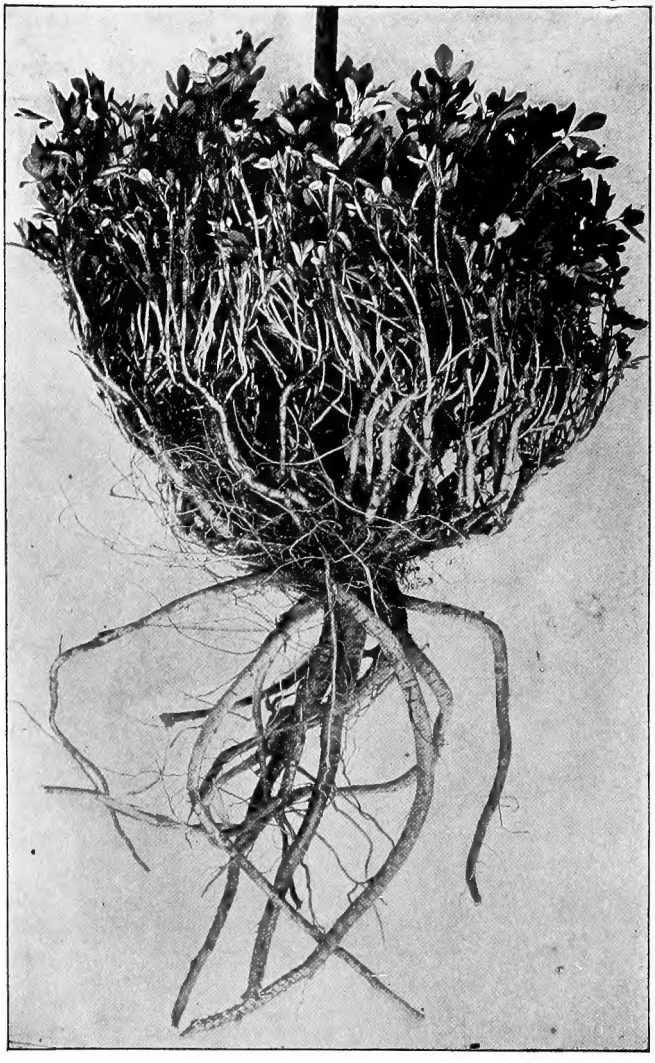
ALFALFA

(MEDICAGO SATIVA)

F. D. COBURN





SIX-YEAR-OLD ALFALFA PLANT GROWN IN COLORADO

ALFALFA

Lucerne, Spanish Trefoil, Chilian Clover, Brazilian Clover, French Clover, Medic, Purple Medic . . . (*Medicago sativa*)

PRACTICAL INFORMATION ON ITS PRODUCTION, QUALITIES, WORTH AND USES, ESPECIALLY IN THE UNITED STATES AND CANADA : : :

BY

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INTRODUCTORY

It is safe to say that in America the increase of interest in alfalfa has been equaled by that in no other agricultural product during the past ten years, and of no other has there within the same period been such a ratio of increase in acreage.

This statement, however, is chiefly applicable to the region west and southwest of the Missouri River, as in the states farther east—and especially where clover is a reliable crop—alfalfa is yet but little known or grown, although reports of its great worth and yields in the semi-arid country are rapidly attracting attention to its possibilities in a vast territory where red clover has occupied undisputed the premier position both for forage and for soil renovation.

The best illustration of quickly appreciating alfalfa is afforded in Kansas, where the increase in area sown has been from 34,384 acres in 1891 to 276,008 acres in 1900, or more than 800 per cent. The enlarged and, in fact, new horizon which a proper utilization of alfalfa, along with some other plants of like recent introduction, opens up to farm and animal husbandry on millions of acres of our domain, before of uncertain utility, is difficult of conception. That its adaptability

for profitably supplementing, if not superceding, in the near future other established forage crops, heretofore regarded as staple if not indispensable in many portions of North America, may be demonstrated by intelligent experiment and by cultivating variations in its habit to suit given localities and conditions is entirely probable.

Those who have known it longest and best are the ones everywhere who esteem it most highly; in fact, very few who have once raised or used it as a feed are satisfied to be without it, and as a rule they contemplate an enlarged acreage and increased use. The marvelous fact connected with this plant so old in agriculture is that it comes, as it does, to so many at the beginning of the twentieth century as an agricultural revelation. To concisely give a wider knowledge of its worth and ways, to encourage its more extended propagation, and be helpful as to the best methods for its growth, care, and use, are the objects of this volume.

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ALFALFA

(*Medicago sativa*)

HISTORY

ALFALFA, or lucerne, has been cultivated since civilization, and was familiar to the Egyptians, Medes, and Persians. It is said to have grown spontaneously in the high dry regions of southern and central Asia, and is mentioned in connection with Persia, Asia Minor, Afghanistan, Beloochistan, and Cashmere. At the time of the invasion of Greece by Xerxes, about 450 B.C., alfalfa became known in that country, and preceding the Christian era was prominent in Roman agriculture. The Romans esteemed it highly as forage for the horses of their armies, and its cultivation has been maintained in Italy to the present time. From Italy it was introduced into Spain and southern France, and was carried to Mexico during the Spanish invasion. When the Spaniard turned his attention to the lands of the Incas, alfalfa found its way to the western coast of South America, where, escaped from cultivation, it is said to be yet found growing wild over large areas. There, in the semi-arid regions of the Andes, it no doubt received a great strengthening of its already strong tendency to survive in a scorching sun upon a parched earth. From Chili it reached California in 1854, and there, mainly under irrigation, flourishes to-day as perhaps in no other place in the world. It rapidly spread eastward, and is now grown largely throughout the humid as well as the arid and

semi-arid regions of the western states and territories, while gradually finding favor farther east.

Eastward from the Pacific coast was not, however, the only route of introduction of alfalfa into America. It was early known in Germany and other northern countries of Europe, but never became so popular there as farther south. As early as 1820, years before it reached California, it was grown in New York, but seems to have been little appreciated.

It is interesting to know that such old-time agricultural authorities as Columella and Jethro Tull were familiar with alfalfa. French lucerne was introduced into England as early as 1650, but seems to have been much neglected for many years. In 1765 a farmer in Kent had fourteen acres. It is stated that at that time alfalfa was recognized as increasing the milk of kine, but an authority who knew it well asserted that cattle "were apt to grow tired of it and are subject to be blown by it." These statements are interesting from the fact that so many consider alfalfa a new plant.

DESCRIPTION

Alfalfa is an upright, branching, smooth, perennial plant, growing one to three feet high. Its leaves are three-parted, each part being broadest above the middle, rounded in outline, and slightly toothed near the apex. The three parts are nearly equal in size, but the size of the leaves varies much on different parts of the plants and on different plants under different conditions. Each part of the full-grown leaf is usually about one inch long and three to four times as long as wide. The purple or violet pea-like flowers, instead of being in a head, as in red clover, are in long, loose clusters or

racemes. The racemes are scattered over the plant, as seen in Fig. 2, instead of being borne, as in red clover, on the upper branches. The ripe pods are spirally twisted through two or three complete curves, and

FIG. 2—ALFALFA

a, *b*. Seed pods. *c*. Seed

each pod contains several seeds. The seeds are kidney-shaped and average about one-twelfth of an inch long by half as thick. They are about one-half larger than red clover seeds, and are of a yellowish-brown or rather of a bright egg-yellow color, instead of a reddish or

mustard yellow. The ends of the seeds are slightly compressed where they are crowded together in a pod. When growing, the field has a dark green color, turning to purple or violet as the bloom appears, and as the pods ripen this is succeeded by a light to dark brown.

BOTANICAL POSITION

Alfalfa, or lucerne, is known botanically as *Medicago sativa*, one of the many species of plants belonging to the important order Leguminosæ. The order Leguminosæ, or legumes, includes such plants as peas, beans, clovers, and vetch. They are distinguished mainly by the manner in which the seed is borne, usually in a pod-like receptacle which splits in halves when ripe. Of late years this order of plants has assumed a position of much interest and importance, in so far as it has been demonstrated that, in association with bacterial organisms, the plants belonging to it have the power of utilizing the nitrogen of the air, which is the most important element of plant-food, and the one most easily depleted in the soil and most expensive to replace. The atmospheric nitrogen is not available to plant use except through the aid of the bacterial organism inhabiting the nodules on the roots of the plants which belong to this order, called legumes. The only exception to this is a very few plants of other orders of no agricultural importance.

VARIETIES

Besides the cultivated form there are two which by some are considered as varieties of alfalfa, while others regard them as distinct species. They are the intermediate lucerne (*Medicago media*), and the yellow, or

sand lucerne (*Medicago falcata*). Neither of them have much agricultural value, though the yellow is sometimes recommended for planting in very light and sandy calcareous soils. It is more easily killed by excess of water, but is said to endure cold. It is probably less valuable than any other species of clover as a forage plant. Alfalfa seed is sometimes adulterated with the seeds of one or the other of the less valuable forms. These plants, however, are so rarely cultivated in the United States that there is little danger of such adulteration being practiced.

The western alfalfa grows taller than the eastern lucerne, and is said to withstand drouth and freezing better. This is probably because it has been so long subject to the peculiar soil and climatic conditions of the arid regions of Chili, California, and Colorado, and become well acclimated. Alfalfa in the West is rarely destroyed by winter freezing, although the temperature in certain regions in which it is largely grown is as low in winter as in the Eastern and New England states. In this latter section the plants frequently fail to survive the second season on account of the freezing of the roots.

During the past few years the United States Department of Agriculture has been introducing an alfalfa found on the elevated table-lands of Asia. The botanical difference is expressed by Russian authorities as *Medicago sativa Turkestanica*. It is supposed, coming from the region it does, to be more hardy than our common alfalfa, and in a measure is gratifying its promoters. It will be further mentioned under the separate heading of "Turkestan Alfalfa."

LENGTH OF LIFE

Alfalfa is a perennial, and the length of time it will continue to thrive, under favorable conditions, is a matter of conjecture. There are fields that are in good condition after more than twenty-five years of constant cropping. Others are reported to be so after very much longer periods. It requires three, and under unfavorable conditions even four, years for alfalfa to reach its prime, and after seven to ten years a decline may generally, yet by no means always, be expected, though if properly cared for there is no good reason why this should be so. Like any other crop, it demands proper treatment for best results, and when this treatment is not given it suffers, and ceases to yield as it would under better conditions.

HABITS OF GROWTH

Alfalfa is a deep and gross feeder. The root system in its development is most interesting for its great power of penetrating, under at all favorable conditions, to the very bowels of the earth. The young plant consists of a number of low branches springing from a central simple basal stalk at the crown of the root. These branches ascend directly above ground in a clump. As the plants become older certain of the more robust stems elongate just beneath the surface of the ground and become new branch-producing stalks, as seen in the frontispiece. In this way one stalk, or rhizome, becomes two or many headed. The plant represented in this plate grew in Colorado, in a rich loose soil, with a heavy clay subsoil, and an abundant supply of water, the water-level ranging from four to eight feet from the surface at different seasons of the

FIG. 2.—ALFALFA SEEDLING SIX WEEKS OLD

year. The diameter of the top was eighteen inches, and the number of stems 360. The picture shows how these crowns gather soil around them, for the length of the underground stem is seen to be several inches, and this represents the accumulation of nearly this much material about the plant. This is one of the largest plants yet found. The specimen as photographed was probably six years old. The root system at first consists of a simple tap-root with numerous small lateral branches. The main root often divides a few inches or a greater distance below the crown, and such divisions occur several times as the root extends downward (Fig. 3), but the main parts of the root grow downward rather than laterally, as seen in Fig. 4.

As the crown becomes broader from the extension of the lateral branches, new roots are sent down from these stems, until after several years as many roots may be found descending from what was originally a single stalk. These lateral branches often become mutilated, accidentally by the trampling of animals or intentionally by use of the disk-harrow, and a portion of a stem is made entirely dependent upon the root descending from it, and becomes an apparently independent plant. This fact makes the disk-cutter an important means of greatly increasing the number of plants in a field. When the stems which grow above ground are cut or grazed off closely they die down to the underground stem, or crown, and new branches are produced from new buds. This method of growth explains why alfalfa is so often injured by continuous close grazing. The stems of most other foliage plants, when cut or grazed off, branch out from lateral buds

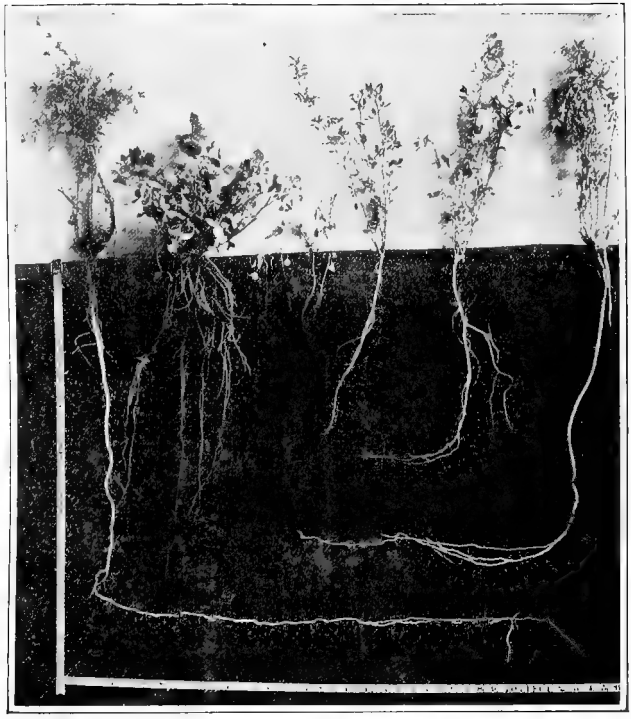

FIG. 4—ALFALFA ROOTS OF ONE TO THREE YEARS' GROWTH AT NEBRASKA EXPERIMENT STATION

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and the alfalfa had yielded three crops. In the greater portion of this trench it was necessary after removing a spade's depth from the top to use a pick to loosen the soil, which was so hard that the men ordinarily did not at one blow drive the picks into it more than two inches; yet, notwithstanding the hardness of this clay soil, alfalfa roots had penetrated the depth of the ditch, five and one-half feet in the deepest place, where the roots appeared little smaller in diameter than they were a foot below the surface (Figs. 5 and 6).

When the alfalfa is once established, if there is sufficient moisture to maintain the plant, it sends its roots in quest of permanent moisture, and is only prevented from reaching it by stone itself. The roots have a strong and well-developed power of passing around obstacles such as stones and boulders, and no crevice is so small as to escape them in their downward journeyings. Fig. 7 shows the development of alfalfa roots in five months from seeding at the Kansas State Agricultural College. The seeds were sown May 1st, and the photograph made October 1st of the same year. The growth shown was on high upland, seventy feet to water, in a very old field never fertilized in any way so far as known. The surface soil is black to a depth of about twelve inches; below this and continuing as deep as excavated is a very stiff, hard, red clay, full of small whitish stones. The top twelve inches of the soil within the period of growth had been wet by late rains, but the succeeding two and one-half feet was so very hard and dry that it could not be spaded at all. At five feet below the surface the soil was moist, and the five and one-half feet of root which penetrated the soil five feet—six inches being taken

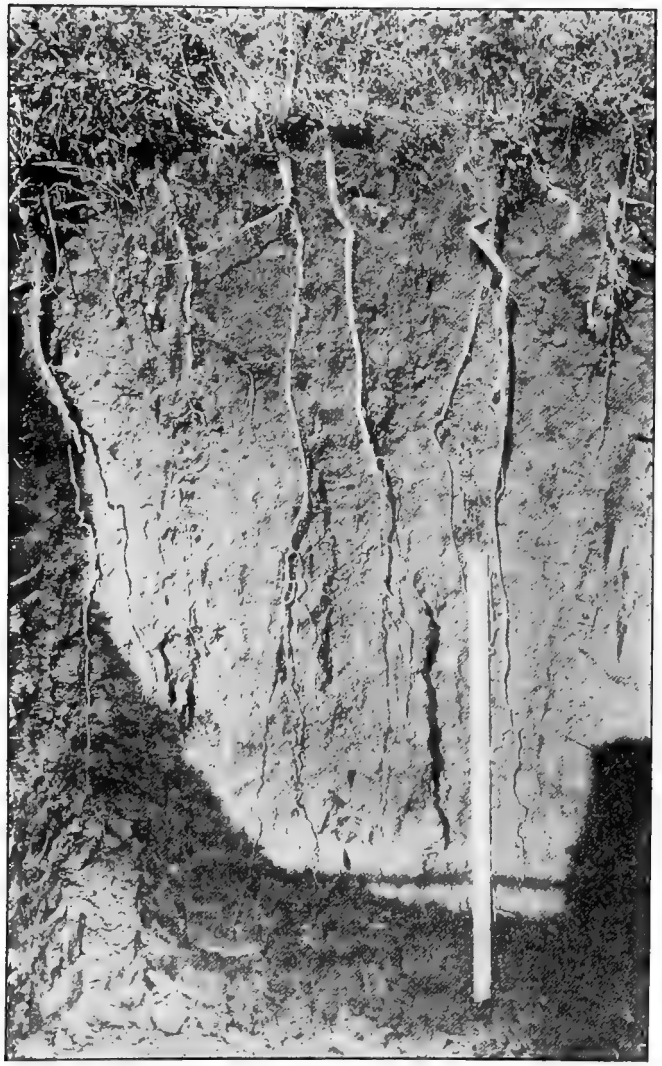

FIG. 6—ROOTS OF FIVE-YEAR-OLD ALFALFA PLANTS AT KANSAS AGRICULTURAL COLLEGE

up in its zigzags—reached moist soil. The shortest plant is from what is known as a "gumbo" spot, yet in spite of the extremely hard subsoil it pushed its root downward thirty inches in the five months. The season was most unfavorable for seeding to alfalfa or any other crop. These plants were treated as nearly as possible according to the methods suggested in this volume; they were cut with a mowing-machine three times during the season.

Mr. Charles W. Irish, chief of "Irrigation Inquiry, U. S. Department of Agriculture," in an article on "Alfalfa and Where to Grow It," makes the following interesting observation: "The writer had an opportunity to observe the great depth to which alfalfa roots will penetrate in search of moisture, while making a survey of a mining tunnel in Nevada a few years since. The tunnel was driven into a rock known to miners as 'rotten porphyry.' It was much shattered and seamed, and through the crevices in the rock in the roof of the tunnel water came out drop by drop; through the same crevices came also roots of plants; these were found to be alfalfa roots, which came down from an old field of the plant over the tunnel through a depth of soil and rock of 129 feet."

This unusual penetrating power is of the greatest agricultural importance. The alfalfa thereby not only obtains its food from far below the root-range of ordinary crops, thus leaving the surface store for shallower feeders, but when these deep-boring roots die and decay they leave not only their own fertilizing properties but innumerable openings for air and moisture and humus from the surface to penetrate. This, at first thought, might not appear of much importance, but in

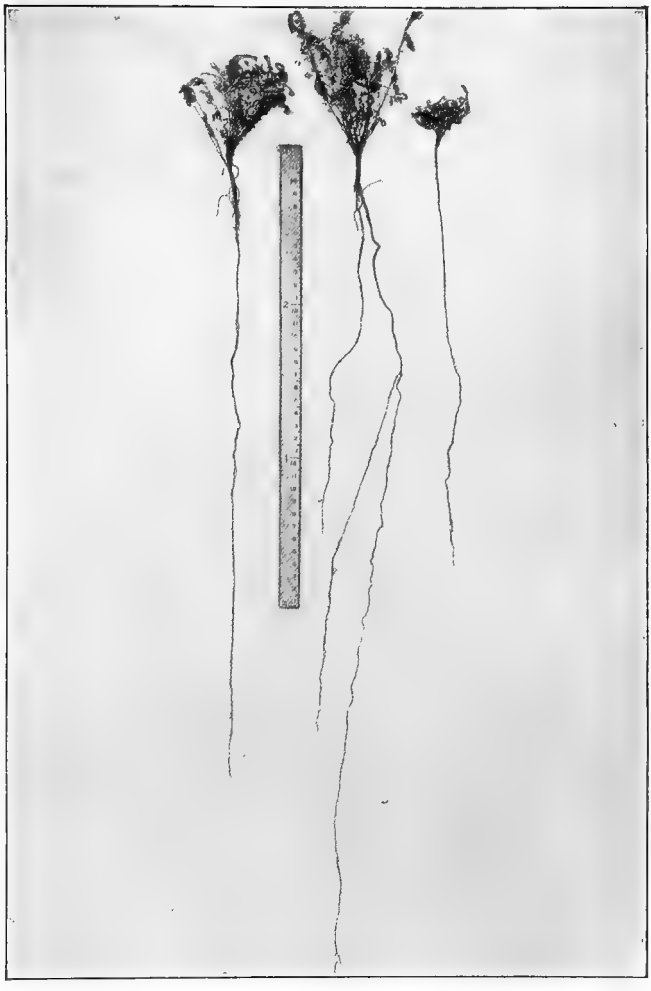

FIG. 7—ALFALFA ROOTS IN FIVE MONTHS FROM SEEDING AT KANSAS STATE AGRICULTURAL COLLEGE

a well-set alfalfa field five years old, five feet below the surface, there would be from ten to thirty roots to each square foot, averaging an eighth of an inch in diameter, reaching directly from the surface. With this fact known, the value of alfalfa as both a subsoiler and fertilizer is more easily appreciated.

CLIMATE AND SOIL

Alfalfa likes a warm climate with a moderate rainfall and a deep alluvial soil of calcareous origin. It has more than the usual variability in adapting itself to the changes in environment, and this affords an argument in favor of "home-grown seed," or using seed from a locality similar to that in which it is desired the future crop be grown. Without detracting from this statement, it may be said there are certain limits which determine the largest prosperity for alfalfa. The limit for rainfall—underground soakage and irrigation not considered—is between fourteen and forty inches. The plant does not grow to be a valuable crop in regions with a less annual rainfall than fourteen inches, unless there is evident underground soakage, or it can be irrigated; and in regions receiving over forty inches of rainfall it does not appear to thrive well. The mean between the extremes mentioned, twenty-five to thirty inches, gives best results. Alfalfa may be said to respond to irrigation as does no other crop. It requires a sufficient supply of moisture at a certain time in its growth to enable it to be most prosperous, and the intelligent irrigator is abundantly rewarded for his painstaking in proper watering.

Alfalfa succeeds in a variety of soils, but reaches its greatest perfection on the deep alluvial sandy loams

of river and creek valleys, or "bottoms." It prefers a light to a heavy soil, but in many localities is grown on the heavy black gumbo flats, and seems to do fully as well or better than on lighter sandy soils. Lime is the favorite mineral element of alfalfa, and iron is very detrimental to it, hence localities with "hard" water are more favorable than those with "soft" water; iron is seldom present in sufficient quantities to be harmful, although it is useless to attempt to grow alfalfa upon land known to contain iron in abundance.

A soil of decaying limestone or calcareous origin is ideal, as it will abound in alfalfa's favorite element, lime, and contain, besides, potash, magnesia, phosphoric acid, and sulphur. It thrives exceedingly well on soil of almost entirely sand, providing the water-table is in reach of its root and the underflow contains mineral elements sufficient to supply abundance of food. It thrives closer to the edge of alkali sinks of the plains than ordinary plants, in a measure accounted for by its being a gross feeder upon some of the identical mineral elements composing the alkali.

Alfalfa will not grow on swampy land. It is a common remark that it will not stand wet feet; that should be qualified, but the land must have good drainage. Water must never stand on the surface of the field for forty-eight hours, and free water must not be present in the soil continuously too near the surface. It has been reported that alfalfa has succeeded where the underflow was within eighteen inches to two feet of the surface, but it came no higher. It does no harm to have the lower roots reach permanent water, as when they do they go no deeper, and remain healthy.

While alfalfa roots deeply it is not essential that

the soil be of great depth, providing it is sufficiently moist and contains plenty of plant-food. The land need not be the richest, but it is a mistake to expect much from alfalfa on land too thin. It will respond on thin land remarkably well, but not to the best advantage; it is not, however, too broad a statement to say that alfalfa will do well on any well-drained soil that will profitably grow wheat or corn. It also follows in drier sections that land which will thriftily grow artificially planted trees will produce alfalfa. It has been seeded successfully upon newly broken wild prairie sod, but it is best to grow several crops of something else before attempting alfalfa.

In trans-Missouri prairie regions ground cultivated three to five years or longer from first breaking is preferable. There are several reasons for this. It is difficult to get the new land in the proper condition for a seed-bed. The grass roots hold the soil loose and it dries out more readily on the surface, which is often disastrous. New ground always responds with ordinary crops more satisfactorily and the available plant-food in the immediate surface can be taken up by shallow-growing crops and the soil be no less suited to alfalfa.

The depth to the water-table does not determine whether a tract of land will be suitable for alfalfa. If it is known that the soil is moist from the surface, or a reasonable depth below the surface, down to the water-level, alfalfa will succeed, providing there be no layer of rock intervening, though the water be ten to forty feet down. But if there be a stratum of dry sand between the surface and the water-level, as is the case in many places along the rivers on the dry plains,

alfalfa will be a failure because it can get no benefit from the water below.

Alfalfa seems to reach its limit of altitude at 8,000 feet, and flourishes from this down to sea-level in varying degree. It will not endure standing or an excess of water as long as corn or wheat will, and it is more readily affected by cold and wet together than ordinary crops. Such conditions obtain in New England, and render the crop more hazardous there than in any other section of the United States. The late fall rains, followed by wet snows and freezing rains together, sometimes leave the surface of the land covered for months with ice. This destroys alfalfa, and many times the ordinary grasses.

PLENTY OF FOOD FOR ALFALFA

The alfalfa plant, being a nitrogen gatherer directly from the air by means of the tubercles on its roots, we need in considering its food requirements to take into account only the mineral elements. Prof. William P. Headden, of the Colorado Experiment Station, who made careful chemical analyses of the plant and the soil upon which it grows, for the purpose of determining its food requirements and the store available for such needs, found that the first 11¼ feet of Colorado soil contains enough phosphoric acid for 1,700 crops of 4½ tons each; enough potash for 954 crops; enough lime for 8,500 crops; enough magnesium for 1,000 crops; and enough sulphur for 600 crops. It will be seen by this that the supply is practically inexhaustible, since alfalfa ten years old may and often does extend its root explorations to double or treble this depth.

THE SEED-BED AND ITS PREPARATION

There are two dominant factors always to determine the preparation of any seed-bed. The first is the character of the seed to be sown, as fine seeds, like those of alfalfa, require a much more carefully prepared bed than would peas or beans. The second factor is the character of the soil; some soils can be brought to a certain desired point of preparation much more easily than others. The point can be seen by comparing a fine sandy loam and a stiff heavy gumbo. Under irrigation, or where rain is scarce, a deep seed-bed is needed in which to hold a store of moisture during the early life of the plant. A deep seed-bed other than for the use just stated is not essential, from the fact that the alfalfa root system is not confined to nor dependent upon so shallow a layer of surface soil as it is practicable to loosen up. Subsoiling or double plowing—following one plow with another in the same furrow—is very excellent as an aid to moisture-storage and conservation in regions where not abundant, but the alfalfa roots quite readily take hold of a hard soil, and hence the deep seed-bed is not always so much of a necessity as for some other crops.

The soil must be made so fine that the particles can come in immediate contact with the seed, and it must be so firmed, by rolling or otherwise, that there will be the minimum danger of drying out before the tender plants have established themselves. These two conditions must not be neglected. The plowed land must not be simply smoothed off on top and made fine, but it must also be so compacted that capillarity will not be interfered with before coming within about two inches of the surface. At this point, two inches,

or less if possible, capillarity should be arrested by loose soil. This allows the moisture to come from below, but arrests it at a point where the seed has been placed for germination. If some implement like a subsurface packer is not at hand to settle the plowed land, it would be best to grow a crop of cow-peas, beans, rape, potatoes, or cabbage, such as would leave the land in fine condition, and then give it only surface cultivation before seeding to alfalfa. If the land should need fertilizing (and alfalfa needs plenty of easily available plant-food to start it vigorously), cow-peas, beans, or vetch would be the preferable crops to grow previously, as they leave an added store of nitrogen easily in reach.

In regions where the soil may be blown badly by the spring winds, it is found advisable on the land intended for alfalfa to grow some sowed crop that will leave a quite heavy stubble. The alfalfa seed should be sown or, better, drilled in, with slight disturbance of the stubble, which keeps the soil from being blown about, and at the same time protects the young plants by holding the moisture near the surface, as evaporation will be much less rapid than if the soil was not so protected. On the high sage-brush lands of Nevada alfalfa is seeded successfully, but the land is not plowed. Many failures there are attributed to plowing the ground, failures being few where the land is merely harrowed and rolled after the brush is removed.

On irrigable lands the ground should first be deeply plowed or subsoiled to form a reservoir for moisture, as very young alfalfa cannot be advantageously irrigated. After plowing, water should be turned on and the soil thoroughly saturated to the depth of a foot

or eighteen inches. After the water has sufficiently soaked in so that the soil can be properly worked, two inches of the surface should be thoroughly loosened by harrowing or otherwise, to provide a mulch for protecting the moisture.

TIME OF SEEDING

The seed should be sown at such a time as to give the young plants the longest and most favorable season in which to grow, so they may be better able to withstand any unfavorable conditions that follow. The alfalfa plant is one of the very weakest during its early life; it is not capable of maintaining itself among a growth of even the least vigorous weeds at the beginning. Cold rains in early spring are detrimental, and slight frost is death to the very young plant, which is in striking contrast with its effects upon the older and well-established growth.

Spring sowing should not be done until the season is well advanced and there is no danger of a cold, wet period, or of frosts. The land to be seeded in the spring should not be plowed unless proper implements are at hand for thoroughly settling the ground again, but should be cultivated shallow at frequent intervals, and especially as soon as suitable after every rain. When the proper time, as indicated, comes for seeding, should the ground be too dry or in any way unsuitable, the seed had better be saved. If the spring conditions do not become satisfactory, some such quick-maturing crop as millet, or, better, early peas or beans, may be grown on the land and removed in time for fall sowing. The lighter the crop grown on land before fall seeding the better, as there is then

more likelihood of there being a large store of moisture in the soil. It is even advisable to summer-fallow. This cleans the ground of weeds and puts it in the best possible tilth.

Fall seeding is advisable where grass and weeds are likely to badly choke the young plants, a probability in nearly all sections where the rainfall is quite heavy. Fall seeding should be done after the rains have come and the ground is in good condition. If this time does not come early enough, so there is yet a growing season sufficient for the alfalfa to make good growth of six to eight inches before cold weather, the seeding had better be deferred. Severe winters are likely to be disastrous to young, late-sown alfalfa, and for this reason fall seeding is not as advisable for northern as for more southern sections.

The question of time of seeding is a very broad one, yet it is a fact that there is not a month in the year when there have not been successful seedings of alfalfa in the United States. Even in Kansas and Colorado the range of time of seeding is nearly as great. The would-be grower must count the difficulties most liable to thwart his efforts, and use his own judgment as applied to his individual case. To recapitulate, if the soil is in condition in the spring, and there is not liable to be too long a dry period during the summer, when a few weeds only would be likely to materially injure the young plants, and especially if the winters are severe, spring sowing would be preferable. But if the weeds are sure to be rampant, and there is a sufficiently long growing period after the ground has been brought into proper condition by late summer or early fall rains to enable the alfalfa to get large enough to

withstand the winter, fall seeding may do best. There are, however, localities in which it would make no difference at what time the seeding was done, as before the alfalfa was well started the sower would wish the seeding had been done at some other time.

QUANTITY AND QUALITY OF SEED

The quantity of seed to sow on an acre is a question of no little importance, but growers differ widely in their opinions. The limit is from twelve to thirty pounds, owing somewhat to the method of seeding. The favorite quantity is twenty pounds to the acre. If the seed were universally good, and the ground always well prepared, this would be grossly extravagant. Professor Headden has made some interesting observations upon the "stand" of alfalfa in a number of meadows. A field of alfalfa six months old was found to contain 653,400 plants per acre; another field ten years old was found to contain 526,793 plants per acre; another contained 139,392 plants to the acre. All of these three fields yielded practically the same quantity of hay per acre—a little over four tons. Another field twelve years old was found to contain only 70,283 plants per acre, and yet yielded over three tons of hay per acre. The stands in these different fields were respectively fifteen, twelve, three, and less than two plants per square foot. A pound of alfalfa seed contains about 210,000 seeds. If ninety per cent of them germinated, twenty pounds per acre would give 3,780,000 plants, or eighty-eight per square foot. After nine-tenths of the young plants perished from crowding or accident there would yet be an ample stand. From these facts one can readily find reasons for differ-

ence of opinion among good farmers as to the quantity of seed to sow. As low as eight to ten pounds per acre have frequently been used with satisfaction.

The quality of the seed is another most important factor. Good germinable seed should always be used. The percentage of germinability should be ascertained by a test before sowing. This is easily obtained as follows: Count out 100 seeds and place between two pieces of muslin. Invert a small dish in a larger vessel and pour water around it. Place the muslin with seeds on inverted dish. Let one end of the muslin hang down into the water. Saturate muslin and seed before putting them into the germinator, and set the whole in a warm place. The sprouted seeds should be counted and discarded at intervals of two or three days until all have germinated that will do so. The number germinated will give the per cent. of germinability. This ought not to be less than seventy-five per cent.

Farmers are often cautioned against buying old alfalfa seed. Moderate age is no drawback. Seed six years old has been known to show a germinability of ninety-three per cent., and a German experimenter kept alfalfa seed bottled up in nitrogen gas for seventeen years, and at the end of this time it showed a germinability of fifty-six per cent.

A statement from one of the eastern experiment stations, made a few years ago, that alfalfa seed more than one year old will not germinate has been largely copied by the agricultural press. This statement is wholly erroneous, and should be corrected. The quality depends upon how it is harvested and handled. Good, plump, well-ripened seed will keep ten years

without great deterioration. Shrunken seed will show a lower percentage of germinability at any time.

TABLE SHOWING GERMINABILITY OF ALFALFA SEED.
Tests made by PROF. GEO. L. CLOTHIER.

Sample No.	DESCRIPTION.	Years old.	Source.	By whom contributed.	Percentage germinated.	Remarks.
1	Fairly plump, color yellowish brown.	At least five.	France.	Dr. Otto Lugger.	81	
2	Fairly plump, size of seeds uneven, color yellowish brown to almost black.	At least five.	Buenos Ayres.	Dr. Otto Lugger.	72	
3	Plump, color greenish yellow to brown.	Two.	Commercial.	Northrup, King & Co.	85	Average of two tests.
4	Plump, color greenish yellow to brown.	One.	Commercial.	Northrup, King & Co.	89	
5	Plump, color brownish yellow to brown.	Five or more.	Kansas.	H. H. Clothier.	79	
6	Some shriveled, color brownish yellow to black; probably stack-burned.	Crop of 1897.	Kansas.	A. F. Thayer	31	
7	Many shriveled seeds, color greenish yellow to brownish yellow.	Bought in 1897.	Kansas (?)	Thomas Walker.	56	
8	Badly shriveled, color brown to black.	Crop of 1896.	Kansas.	A. E. True.	49	
9	Plump, color yellowish brown.	Bought in 1891.	Unknown.	Allen Phillips.	45	
10	Plump, color yellowish to reddish brown.	Bought in 1891.	Unknown.	Minnesota University.	43	
11*	Seeds rather uneven in size, color greenish yellow to brownish yellow.	Crop of 1899.	Commercial.	F. Barteldes & Co.	76	A number of seeds that will probably germinate yet.
12*	Seeds uneven in size, some shriveled, color greenish yellow to brown.	Crop of 1899.	Commercial.	F. Barteldes & Co.	76	A number of seeds that will probably germinate yet.
13*	Seeds uneven in size, some shriveled, color greenish yellow to brown.	Crop of 1899.	Commercial.	F. Barteldes & Co.	63	Some good-looking seeds that will probably germinate yet.

* Nos. 11, 12, and 13 were only kept in the tester seven days.

The following Tests were made by PROF. WM. P. HEADDEN, in Colorado.

No. of sample.	DESCRIPTION.	Years old.	Per-centage germi-nated.
1	Prime seed	2	96
2	Prime seed	2	92
5	Prime seed	3	98
6	Prime seed	6	93
7	Screenings, first quality	1	66
8	Screenings, first quality	2	55
9	Screenings, first quality	3	79
10	Screenings, second quality	2	38
11	Screenings, third quality	1	38

The foregoing tables illustrate the germinability of seed of different ages and qualities. The variations shown by Clothier are largely due to quality of seed at the time of thrashing and not to age. There need be no hesitation in sowing seed that shows a germinability of only forty per cent., but such seed should be purchased at a price correspondingly low, and the ordinary quantity per acre doubled. Buyers should insist upon a guarantee of a certain percentage of germinability, and beware of seed that has a reddish-brown or black color. This has probably been injured in the stack by heating. Alfalfa that has molded, heated, or "stack-burned," should never be thrashed for seed.

F. Barteldes & Co., seedsmen, of Lawrence, Kansas, give the following rules to be observed in selecting and determining the quality and purity of the seed, aside from actual tests of vitality by germination:

"In the first place, the best new seed is uniformly of bright golden-yellow color. From various causes, however, which do not affect its vitality, new seed is more or less discolored. Seed kept after the first year grows darker in color, and its vitality decreases,

though to what extent we are unable to say with certainty. As to how to determine if seed has been 'stack-burned' we are also unable to give information that would be reliable, but are of the opinion that it would be much darker in color with evidence of mold appearing on the seeds. All we can do is to test such seeds as do not show absolute worthlessness. Next, it is of the first importance to see that the seed is pure, and free from foreign seeds. The most common of these, and hardest to detect by the uninformed, are Bokhara (or 'sweet') clover and dodder. The former closely resembles alfalfa seed in size and color, but can easily be detected by its odor. The latter is of the same color, but round and much smaller, and can be removed in cleaning."

METHOD OF SEEDING

The alfalfa seed being very small contains but little plant-food, and no more can be obtained until the young plant has unfolded its first leaves in the sunlight and its roots have taken hold of the soil. If planted too deep it will not have strength sufficient to push through the soil above it, and if planted too shallow germination may begin, but the soil dries out around the seed and the plant dies. Hence, whatever method is used, the object must be to place the seed in the most advantageous position possible for its best growth.

The two general methods of seeding are broadcast and in drills; broadcasting generally requires five to ten pounds more seed per acre. The relative merits of the two methods are determined somewhat by the condition of the soil with respect to moisture. If thor-

oughly moist there is no benefit derived from having the seed covered to any considerable depth. The land should be well smoothed before sowing and lightly harrowed afterward. If the soil is inclined to be light it is an excellent practice to roll, after harrowing the seed in, and then harrow very lightly again. The surface should never be left as smooth and hard as a roller leaves it, as on most soils a crust may form which the young plant cannot push through. It should always be left loose on top after sowing.

In using the drill the seed should be put just into the moist soil, and the depth of the drill regulated accordingly. If there is over two inches of dry, loose soil on top it will be putting the seed too deep to go below this. Alfalfa seed properly should not at most be covered more than one inch. In some very light soils one and one-half inches may give success, but the rule is, plant as shallow as possible to insure getting the seed in soil sufficiently moist to cause vigorous germination. For soils that are light and rather inclined to be dry using a drill with press wheels is much preferable. The wheels press the soil about the seed, which greatly facilitates germination. Few grain-drills are built to handle satisfactorily as small seeds as those of alfalfa, but this is overcome by mixing the seed with equal parts, by measure, of coarse corn-meal or some other substance that will feed out evenly. By knowing the length of the field and measuring the mixture for a few rounds the proper adjustment of the drill can be obtained. The practice of drilling half of the seed one way and then cross-drilling with the other half has merits, as there is less liability to bare spots where the drill may have failed to work, and the seed may be

more evenly distributed. In many places where it has been found impossible to secure a stand by the ordinary methods on account of weeds, the seed is planted in drill-rows wide enough apart for cultivation by horse-power. This is practiced in the Southern states and considered best.

In England and some European countries the method is employed of growing the alfalfa plants in a nursery until eighteen inches high and then transplanting. This destroys the tap-root, it being necessarily cut off ten to twelve inches below the crown. The plants are not difficult to transplant, and are set in rows six inches apart with two feet between the rows, and cultivated.

NO NURSE-CROP

Alfalfa cannot be guaged by red clover in any respect. The question of a nurse-crop has sufficiently passed the experimental stage to say that alfalfa should be planted alone. There have been satisfactory results from seeding with oats or barley, but the success was in spite of, and not because of, the nurse-crop. The young alfalfa after attaining some hight is aided by frequent clippings and needs the sunlight, neither of which is permissible if the nurse-crop is present. The greatest disadvantage of the nurse-crop is that in many cases it takes from the soil the moisture needed by the young alfalfa at some time during the season. A light nurse-crop may be advantageous on a light soil that blows about badly, but it is preferable to have as protection only the stubble from a previously grown crop. Alfalfa demands, at a risk of failure, exclusive possession of a soil or seed-bed, and that in the best

possible condition. It is very exact in its requirements, and for neglect of these while young it refuses to respond when older.

TREATMENT OF THE YOUNG ALFALFA

The first few months of its life is the critical period. After acquiring several pairs of leaves it will endure a great deal of hot weather, but will not withstand wet to the same degree. The irrigator can control the water, while all the non-irrigator can do is to so manage as to avoid as much as possible unfavorable conditions. Should a heavy rain settle the soil together and form a crust, a light harrow should be used to break it. Even if considerable of the seed has sprouted the harrowing will be more a benefit than harm. A crust over the alfalfa seed is death to the young plants—they break their necks trying to get through—so there is nothing to lose by harrowing and everything to gain.

Alfalfa is invigorated by cutting at frequent intervals, the cutting tending to prevent the production of seed. Bearing seed is an exhausting process to any plant. It is asserted that a seed-crop taken from an old field of alfalfa is as exhausting as three earlier cuttings of hay. The sickle-bar should be set so as not to cut too close to the ground. It is a mistake to mow the young alfalfa field only for getting rid of the weeds—a secondary consideration; it should be mowed at such frequent intervals that there will not be enough of the clippings to smother the plants when left on the field for mulch. In a growthful season once every two weeks may not be too often, and the other limit may be determined somewhat by the rapidity of the

growth, but not exceed a month. Getting an alfalfa stand successfully through the first year is the greatest difficulty; the second year frequently brings perils, but a discouraging field should not be abandoned too soon. Often what appears to be a very poor stand will surprisingly thicken up; the disk-harrow is an invaluable implement to aid this. After alfalfa is well started it is very hardy, and is ordinarily quite equal to the crowding of weeds and grasses.

ALFALFA FOR PASTURE

Alfalfa can be and is grazed by all kinds of stock, except possibly such ruminants as cattle and sheep. Many have pastured it for years without the slightest loss therefrom, but it cannot be said that there is no danger in pasturing sheep and cattle on alfalfa alone. Experience in this seems to vary so much that it is impossible to give any rule universally applicable, except that an occasional loss may be expected. There is no danger in pasturing hogs and horses on alfalfa, the liability to bloat being wholly confined to ruminants. Danger seems to be quite if not wholly mitigated by sowing half the quantity of seed of some perennial grass with it. Kentucky blue-grass, meadow fescue, orchard grass, timothy, or *Bromus inermis* are all suitable more or less for their respective sections. *Bromus inermis* promises to be a favorite for the purpose, especially in the drier regions, as it has practically the same reputation for hardiness as has alfalfa.

Alfalfa pastures are very enduring when judiciously treated. Alfalfa will not stand pasturing the first year; it should be but very moderately pastured

the second, and never closely. It is very desirable to mow pastures occasionally to keep them fresh, and to prevent the exhaustive process of seeding by many of the plants. Alfalfa should never be pastured so late in the fall that there will be no protection left for the crowns during winter; stock should not be allowed in the pastures when there is a slight thaw, with frozen soil below, as much harm may be done to the crowns. Hogs will root out patches occasionally if not given sufficient range; ringing or slitting the nose is sometimes done to prevent this. Ten young hogs per acre will not damage alfalfa, and should make 1,000 pounds of gain in a season, under ordinary conditions, without grain. However, alfalfa is better adapted to the making of hay, or for soiling, than for grazing, with perhaps the exception of pasture for hogs. It is doubtful whether as large returns can otherwise be secured from land, with as little outlay, as by pasturing alfalfa with young hogs.

ALFALFA FOR SOILING

There is no other plant that can take the place of alfalfa for mowing and feeding green in summer. It comes early in the spring, stays late in the fall, and if properly handled and the season favorable it can be cut every day, and for feeding value is not equaled. It is relished by every class of farm animals. For dairy purposes it is par excellence. The quantity of feed a few acres will furnish when rightly managed is almost incredible. Ten mature cows, giving milk, have been fed the entire summer on the alfalfa from four square rods less than two acres. A cutting was made once each day, and the cows fed from it twice

daily, without other feed. The growth was not pampered, nor were the conditions more favorable than is common on average Kansas river "bottom" land. There will be a little irregularity in the first cutting—the first of it being a little immature, the last somewhat too ripe—but later there need be no difficulty; it can be cut at exactly the proper stage. It is perhaps best at any time to let the hay slightly wilt before feeding, but this is not important. When the hay is used very green, and is of rank growth, especially when wet from showers or heavy dew, there are occasional cases of bloat among cows eating it, but such cases are so infrequent that they need not be greatly feared. An alfalfa field grown for soiling at the Minnesota University Experiment Farm is shown in Fig. 8.

HARVESTING

A correct understanding of the best methods, and experience in applying them, in handling alfalfa hay is important in determining the greatest satisfaction with the crop. Dissatisfaction, or an improper estimate of the value of the hay, comes more from injudicious harvesting than any other cause. The art of handling this crop is peculiar in itself, and can only be fully learned by experience. Experience teaches that for the best results it should be cut for hay when the first one-fourth or one-fifth of the blossoms have appeared. If a great deal is to be cared for, cutting should begin earlier, so as to be completed before the last is too ripe.

All classes of animals prefer the early cut, but the late cut is better for work-horses, being less washy, and not so liable to unduly or unfavorably excite the

FIG. 8—ALFALFA GROWN FOR SOILING AT MINNESOTA UNIVERSITY EXPERIMENT FARM

digestive and urinary organs, as does the early cut hay used too freely. Hogs and milch cows respond most favorably to the early cut hay.

Curing is attended with more or less difficulty in regions of much humidity. It is very important that the hay be stacked or stored without being rained on, or even left spread in a heavy dew. Its value as a feed is largely due to the fact that it is easily digested. The food elements are not securely held, hence they wash out very readily. The damage by rain depends upon the time the hay has lain also, but it is safe to say that a rain of one-half to one inch will damage the hay from twenty-five to fifty per cent. The loss does not all come from washing, but the leaves, which are the most valuable part, after being wet shatter from the stems easily and are lost. No more of the crop should be mowed at once than can be handled in one day, and this should be raked into windrows as soon as wilted. If the crop is very heavy it should be gone over with a tedder three or four hours after cutting, so that the curing will be uniform.

Alfalfa when subjected to extreme drouth tends to protect itself by shedding its leaves, and if not properly handled this occurs in curing. The hay should be put in the windrow before the leaves are brittle, and it may be left in this condition until ready to stack or put in the mow. It may be advisable to cock and let thoroughly cure, especially in sections where the climate is more or less damp. The cock should be high and narrow, and should be opened out to dry if necessary. In the Central and Western states, except in very wet seasons, which are not frequent, the alfalfa is cut and raked the same day and put into

stacks the next. The side-delivery rakes, loaders, or buckrakes, and hay-forks, or stackers, are used, so there is very little hand-hauling. When cured disturb as little as possible, as there is always a loss of leaves from handling. The hay can be put into stacks or mows when the stems are quite tough, or flexible, with little danger of damage; if the precaution is taken to sprinkle salt on the hay at the rate of ten to fifteen pounds to the ton it can be safely stacked while quite damp. Air-slacked lime at the same rate also lessens danger of "burning" in the stack. It will be found that alfalfa hay can be stacked much damper than is commonly supposed, and one of the secrets of handling is to never let it get thoroughly dry until stacked. The leaves are of more value than an equal weight of wheat bran. If the hay gets too dry and the leaves shatter badly in raking, it is advisable to leave it and rake early in the morning when the dew is on.

Sheds for hay are good investments, but when the hay must be stacked in the open, the stack should be made narrow at the bottom and run straight up, or, better, bulge somewhat, until of a convenient hight to begin topping it out. Stack-covers of lumber make a great saving; tarpaulins or long slough-grass can be used advantageously, or in case none of these are to be had, the stacks can be topped with the green hay two feet in depth. This packs down and forms a much better protection than the cured hay, and, being on top, cures and becomes good hay itself.

Occasionally a season is so wet as to make stacking or storing in barns impossible, especially the first cutting. This may be in a measure overcome by stacking with alternate layers of dry straw. The straw is made

more palatable thereby also. It is always advisable to have air spaces under the stacks or mows if the floors are tight. This may be accomplished by putting down poles, brush, or the like, on which to start the foundation. Ventilators may be put in the mows, built rack-fashion, two feet square from the floor up. A barrel set, the hay built around it, and the barrel raised from time to time, as the mow fills, forms a very effective ventilator.

While there are many opinions as to what extent hay is damaged by discolorations in the stacks, or whether at all, the strongest demand is always for the brightest colored and most perfectly cured. It is hardly too broad a statement, however, to say that alfalfa cannot be damaged in the stack to such an extent that cattle will not eat it.

There is always some difference in the quality of the hay from different cuttings. The first cutting is generally coarser, and is best fed to stock cattle and horses. The second and later cuttings are good for all stock.

COMPARISON OF YIELDS

Prof. C. L. Ingersoll, of the Nebraska Experiment Station at Lincoln, planted clovers, including alfalfa, and several of the tame grasses. The alfalfa, he says, in spite of a dry spring, grew finely, and in the fall, during the prolonged and dry period, it was the only green plant in the whole list. No fertilizers were used; the ground was simply plowed, harrowed until very smooth, and after sowing was all lightly harrowed and smoothed with a plank drag. During the first season the plats were mowed once, and the weeds and surplus

grass raked off. The following table shows the yield of each variety the next year:

Plat No.	VARIETY GROWN.	*Hay, lbs.*	*Yield per acre.*
1	June clover	473	2,365
2	Mammoth clover	475	2,375
3	Alsike clover	413	2,065
4	Alfalfa (first cut)	816	4,080
5	Blue-grass	575	2,875
6	Orchard grass	478	2,390
7	Timothy grass	560	2,800
8	Red-top grass	470	2,350
9	Meadow fescue	375	1,875
10	Tall meadow oat grass	600	3,000
11	Italian rye grass	...	.....
12	Timothy, blue-grass, orchard grass	203	1,015

Professor Ingersoll calls attention to the great difference in the yield of forage (cured hay) per acre in the last column, varying from 1,015 pounds to 4,080, the latter being for alfalfa, while the former was the plat of mixed grasses. He further says:

"In justice to Plat 12 we will say that this was located too near a row of well-grown cottonwood trees, and thus, to some extent, robbed of plant-food and moisture. But the comparison does not end here. The alfalfa plat kept on growing by means of its deep roots, and when in blossom was cut twice more. The other plats made no aftergrowth worth mentioning. The alfalfa crop then stood as follows for the second year:

	Hay, lbs.
First cutting	816
Second cutting	805
Third cutting	743
Fourth cutting (estimated)	180
	2,544

"This, being for one-fifth of an acre, gives as the total production per acre 12,720 pounds, or, approximately, six and one-half tons of good, dry forage. What plant do we grow that, without special care, will give greater or even an equal return of good, palatable forage?"

SCIENTIFIC FEEDING

Before going into the details of questions arising out of the practice of feeding alfalfa, it seems best to discuss the fundamental principles which govern the estimation of the feeding value of any feedstuff. Notwithstanding the facts that much good work has been done and is being done in the scientific feeding of domestic animals, and that the published results of the experiments are accessible, yet those who comprehend or use well-balanced rations in every-day practice are not nearly so numerous as is desirable. No farmer can learn to feed alfalfa in the most economical way until he understands the compounding of a balanced ration. All foodstuffs for either man or beast are made up of three classes of substances—namely, protein or proteids, fats, and carbohydrates. The animal's digestive and assimilative organs are so constructed that it can not use these three classes of substances interchangeably; in other words, an animal fed wholly upon any one of these three substances would gradually starve to death. When mixed in the proportions needed to supply the vital organs of the body with material and energy, these substances become the source of animal life. The protein goes to build up the brain, nerves, muscles, and other tissues in which the life force is active. Without protein there would be no life.

Protein contains nitrogen, while the carbohydrates and fats have none of this important element. The white of an egg is almost pure protein; the gluten of the wheat flour and the lean meat are eaten by man to supply his body with protein. The green leaves of plants and their tender growing shoots are gorged with large quantities of protein; this is true of alfalfa in a superlative degree. The carbohydrates are such substances as starch, sugar, and vegetable fiber. The fats and carbohydrates supply heat to the body and build up fatty tissues. Protein may be broken down in such a way by digestion that it will liberate heat and go to help build up the fat, but the carbohydrates and fats can not build up muscle or nerve tissue. From the foregoing facts it is evident that protein is the most important substance in a feedstuff.

To balance a ration for domestic animals is to so adjust the quantity of digestible proteids, fats, and carbohydrates therein contained that the animal economy may use all of these substances without any waste. The balanced ration means an economical ration, which allows the digestive organs of the animal to work at their highest efficiency. An unbalanced ration is one in which either one of the three classes of food substances is in excess. When fed such a ration, the animal retaliates upon his owner by inability to digest the excess, which is worse than wasted; for the feeding of any class of substances in excess adds to the labor of the digestive organs of the animal, thus reducing their efficiency.

FEEDING ALFALFA HAY

The digestibility of alfalfa is changed less by the process of curing than that of any other forage plant.

Dry alfalfa hay is in the midst of summer about as palatable to the dairy cow as the finest Kentucky blue-grass. The ideal way to feed alfalfa is as hay. This saves the labor of handling the excessive quantities of water present in green plants. Fed dry, the danger from bloat is avoided, and the quality of the feeding constituents is not reduced by the dryness in the least. The only way that alfalfa hay is liable to deteriorate in value is through poor handling or exposure to bad weather. If fifty per cent. of the leaves are lost in the handling, as is frequent, the remainder of the hay will be composed of a large percentage of indigestible vegetable fiber. Molding or heating destroys some of the most valuable nutrients. Properly housed and cured alfalfa does not deteriorate with age. It possesses largely the succulent qualities of green grass in June, keeping the digestive organs open and active; it has a cooling effect upon the blood, and cannot be surpassed as a feed for cows during calving time. Fed to dairy cows, alfalfa maintains the flow of milk equal to June grass for nearly the whole year. It can be chopped as fine as wheat bran and mixed with corn-meal to form a balanced ration. Such a mixture is worth more, pound for pound, than the original corn-meal. Where alfalfa grows to perfection is a cow paradise, and such a land is certain to "flow with milk and honey," if man does his part toward such a consummation.

In computing the value of alfalfa hay as a feedstuff for the balanced rations, 10.6 pounds is taken to represent the digestible protein in one hundred pounds, as given in Henry's "Feeds and Feeding." The digestion experiments at the Kansas Experiment Station show the average digestible protein of prime alfalfa

hay to be 12.9 pounds per hundredweight. According to these latter figures, one acre of alfalfa yielding four tons of hay would produce 1,033 pounds of digestible protein, while an acre of corn yielding thirty-six bushels would produce in the grain only 157 pounds. Since protein is absolutely essential to the production of milk we readily see from these figures the comparative values of corn and alfalfa hay for dairy purposes.

The following table shows the comparative values of alfalfa hay and other common feeds, calculated upon the quantities of digestible protein contained in each. The alfalfa given the second time in the table is assumed to be equal in feeding value to the average product well cured, as has been shown by recent digestion experiments. It is seen that hay of such quality is equal to or even better than wheat bran, pound for pound:

COMPARATIVE VALUES OF ALFALFA HAY AND OTHER FEEDSTUFFS FOR PROTEIN.

NAME OF FEEDSTUFF.	*Value per ton when prairie hay is worth per ton—*		
	$2.00	$3.00	$4.00
Alfalfa hay (average)	$6.05	$9.08	$12.11
Red clover hay	3.88	5.82	7.77
Orchard-grass hay	2.74	4.11	5.48
Millet hay	2.57	3.85	5.14
Timothy hay	1.65	2.48	3.31
Sorghum hay	1.37	2.05	2.74
Corn-fodder (stover)	1.14	1.71	2.28
Oat straw	.91	1.37	1.82
Wheat straw	.45	.68	.91
Sugar-beets	.62	.94	1.25
Mangel-wurzels	.57	.85	1.14
Alfalfa hay containing 12.9 per cent. digestible protein	7.36	11.05	14.73
Wheat bran	7.02	10.53	14.04

For stock-cattle there is no better feed than alfalfa hay. The minerals contained in it are what the young animals need to build the bones of their bodies. The protein builds up their muscles, nerves, and tendons, giving vitality and strength. A steer grown on alfalfa balanced with other fodders will be more valuable to fatten than one fed entirely upon the highly carbonaceous grains. Calves will leave their grain to pick up alfalfa stems and leaves left as refuse in mangers of dairy cows.

FEEDING VALUE OF ALFALFA HAY

"The philosophers have been inquiring into the secret of the alfalfa plant, and they have found that the hay is, in money value, forty-five per cent. better than clover and sixty per cent. better than timothy," says *The Field and Farm*. "This carries out our long-expressed theory that alfalfa is the greatest all-around forage plant the world has ever known. To secure a good milk ration by the use of timothy hay, protein must be supplied from some other source, in order to secure a ration that will give a sufficient amount of that material without entailing a loss of carbohydrates and fats; clover hay, however, is a fairly good ration in itself, and it can be economically used without the addition of any other compounds; alfalfa hay, on the other hand, requires the addition of large amounts of both fat and carbohydrates in order to be profitably utilized as a milk ration.

"This fact renders alfalfa even more serviceable than its valuation would indicate, since, in the management of farms, either for dairy purposes or for grain, an excess of carbohydrates is secured, which in the

great majority of cases is wasted, either through lack of proper material from other sources with which to balance the ration or through ignorance of the real loss incurred. Under ordinary conditions, 2½ pounds of protein, four-tenths of a pound of fat, and 12½ pounds of carbohydrates can be profitably fed daily to a milch cow of 1,000 pounds live weight. One ton of alfalfa hay, containing 35.3 pounds of digestible fat, 280.1 pounds of digestible protein, and 770.7 pounds of digestible carbohydrates, would furnish sufficient protein for 112 days, fat for 88 days, and carbohydrates for 61 days.

"Therefore, in order to feed this amount of alfalfa economically and profitably, fat sufficient for twenty-four days and carbohydrates for fifty-one days must be added from some other source. In securing these fats and carbohydrates, it is impossible to avoid adding protein to a slight extent, since all farm products that are of any value for feeding purposes contain more or less protein; this addition of protein, however, may be, and should be, reduced to a minimum by selection of those materials which contain it in the smallest quantities. Among these may be mentioned field cornstalks, green fodder corn, or ensilage, wheat straw, oat straw, root crops, and so forth. One ton of field cornstalks, containing seventeen pounds of fat, sixty pounds of protein, and 1,076.6 pounds of carbohydrates, would furnish sufficient protein for twenty-four days, fat for forty days, and carbohydrates for eighty-six days.

"Two tons of a mixture of equal weights of field cornstalks and alfalfa would therefore furnish food sufficient for 136 days without noticeable loss of any

of the digestible compounds. In case of corn ensilage, every ton of which contains six pounds of fat, 24.4 pounds of protein, and 296.6 pounds of carbohydrates, three tons would furnish sufficient protein for twenty-eight days, fat for forty-five days, and carbohydrates for seventy-one days. Four tons of a mixture composed of one ton of alfalfa hay and three tons of ensilage, or green fodder corn, would therefore furnish food sufficient for 136 days without any appreciable loss. Alfalfa thus furnishes the farmer a feeding material rich in protein, which can be substituted for such waste products as wheat bran, cottonseed-meal, etc., usually bought in order to profitably utilize the excess of carbohydrates.

"There is no way in which more net profit may be secured from an acre of good alfalfa than by pasturing young hogs upon it. One acre should sustain ten to fifteen hogs from spring to fall. If they weigh one hundred pounds each when put on the alfalfa, they should be able to make another hundred each from it during the season. Ten hundred pounds at five cents is fifty dollars, and there is no expense to be deducted. Six hundred pounds of pork from an acre of corn would be a good yield, and then the expense of cultivating, and harvesting, and feeding would make a big hole in the net profit. Pork-making from alfalfa is one good road to success."

ALFALFA *vs.* CORN

Prof. W. W. Cooke, of the Colorado Experiment Station at Fort Collins, relates this in his Bulletin No. 26:

"Throughout the northern half of the Mississippi

Valley corn is the great crop. It produces more feeding material per acre than anything else that can be grown. In Colorado it meets a worthy rival in alfalfa. Both these crops were grown side by side, in acre plots, on the station farm. The land was in good condition, and in addition a very heavy application of stable manure was given to the corn ground, so as to show it at its best. Colorado is not so well adapted to corn culture as are Kansas and Nebraska, owing to cool nights, high altitude, and near presence of the mountains. But the crop of corn to be described would compare well with the Eastern and Middle states, being equivalent to one of their crops of fourteen tons of green fodder per acre. It is also fully up to the average of the great corn states of Kansas, Nebraska, and Iowa.

"The variety was the Golden Beauty, planted May 16th, in hills three feet apart each way, harrowed two times, cultivated four times, and irrigated once. It was harvested September 21st, and the entire crop, ears and stalks, weighed 15,500 pounds per acre. The analysis showed 35.62 per cent. of dry matter, so that the crop contained 4,539 pounds of dry matter per acre.

"The alfalfa growing on a neighboring plot was not fertilized, and was three years from seeding. It was irrigated twice and cut three times, yielding at the first cutting 4,600 pounds of hay per acre; at the second 3,350 pounds, and at the third 3,250 pounds, a total of 5.6 tons of hay, containing 10,304 pounds of dry matter per acre.

"The alfalfa, therefore, yielded almost twice as much dry matter per acre as the corn. But this is not

quite a fair comparison, for a pound of dry matter from the corn crop is more digestible and has a higher feeding value than an equal amount from the alfalfa. The corn crop contained 3,605 pounds of digestible feeding material, while the crop of alfalfa contained 5,611 pounds, or a little more than half as much again. The corn crop per acre, in feeding value, was equivalent to three and one-half tons of alfalfa hay.

"There is no doubt but that it costs much more to grow and harvest the corn than the alfalfa. Moreover, while the corn crop rapidly exhausts the soil the alfalfa sends its roots deep into the soil, and gathers stores of plant-food from the air, so that it seems, for the present at least, to benefit rather than deplete the land.

"It is evident that in the irrigated portions of Colorado alfalfa is more profitable than corn.

YIELD PER ACRE OF CORN AND ALFALFA.

	Total.		*Digestible.*	
FEEDING VALUES.	*Corn.*	*Alfalfa.*	*Corn.*	*Alfalfa.*
Dry matter . . . lbs.	5,539	10,304	3,605	5,611
Albuminoids . . . "	405	1,602	296	1,198
Starch, sugar, etc. "	3,263	4,782	2,186	3,114
Fiber . . . . . "	1,472	2,800	1,060	1,198
Fat . . . . . "	84	246	63	101
Ash . . . . . "	315	829	.....	.....

"The leaves of alfalfa hay fall off very readily from the stems. A little pounding was sufficient to separate a quantity of hay into two equal parts, one of which was mostly leaves with a few short stems, and

the other mostly stems. Samples of each gave analyses as follows for the dry matter:

	Leaves.	*Stems.*
Ash	12.36	7.05
Crude fiber	25.68	42.47
Fat (ether extract)	3.46	2.95
Albuminoids	13.12	8.61
Starch, sugar, etc.	45.38	38.92
Total	100.00	100.00

DIGESTIBLE PORTIONS OF DRY MATTER.

	Leaves.	*Stems.*
Crude fiber	11.04	18.36
Fat (ether extract)	1.38	1.15
Albuminoids	9.84	6.46
Starch, sugar, etc.	29.49	25.30
Total digestible material in 100 lbs.	51.75	51.27
Nutritive ratio	1:4.5	1:7.2

"It will be seen," says Professor Cooke, "that the two are about equally digestible. But they are quite different in the proportion of their digestible parts. The stems are properly proportioned for horses at moderate work, while the leaves are well adapted to the needs of growing calves and yearlings."

ALFALFA FOR DAIRY COWS

Alfalfa unquestionably holds first place among the feeds for the dairy cow. It is a happy combination of richness and succulence. It has been predicted that the cow fed on alfalfa will in the near future set the price of butter for the world. Alfalfa has the two paramount qualities to enable it to do this: low cost of production in localities adapted to it, and the superior quality of butter produced while feeding it. Prime alfalfa hay is very palatable, and being easily digested

and of a cooling or laxative tendency has an effect on the butter fat similar to green pasture. With it the June conditions, which are most favorable to the production of the finest quality and largest quantity, can more nearly be maintained and at less cost than with any other single food. When used the problem of the balanced ration, which is such a mystery to many dairymen, is solved. The ordinary cow will eat alfalfa hay and corn, or Kafir-corn chop, in just the proper proportions to make the balanced ration.

Professor D. H. Otis, of the Kansas Agricultural College, says: "Alfalfa can be used in place of bran for dairy cows, and is the only single feed that will make a balanced ration with corn, or Kafir-corn. While feeding the hay to dairy cows at this station we have produced butter fat at 11.9 cents per pound. When we did not have alfalfa and were obliged to balance up the ration with high-priced concentrates the butter fat cost us from fifteen to seventeen cents.

"Green alfalfa makes an excellent feed for soiling cows, or for supplementing short or dry pastures. During the summer of 1899 ten head of the college cows were fed green alfalfa for seventy-four days, consuming 77,145 pounds. Deducting the cost of grain fed during the same time, and figuring the butter fat at creamery prices, and skim-milk at fifteen cents per one hundred pounds, the green alfalfa brought us $25.26 per acre. During the last half of June and the first half of July, 1900, the region in which the college is located was suffering from severe dry weather. During this period the tame grass pastures dried up completely, and the wild grass herbage was short and wiry; the flies and hot sun were so bad that the cows would not

graze more than an hour or two per day, and some days would not leave the shade of the trees. We commenced feeding green alfalfa at night, June 21. At that time twenty-one head were yielding 389.8 pounds of milk per day. On July 14, after three weeks of the severest dry weather, the same cows were yielding 390.2 pounds of milk. Cows in the neighborhood without green feed fell in milk yield from fifteen to twenty per cent.

"The dairy farmer who has a good field of alfalfa has something equal if not superior to a Klondike gold mine."

In the following rations, which are figured from Wolff's standard, it will be seen how the use of alfalfa for "roughness" lessens the need of expensive concentrates. In these the portions are given in pounds, and each ration is sufficient for a 1,000-pound cow twenty-four hours, to be given in two or three feeds. The rations in which alfalfa is not used suffice for comparison. If the cost is computed from retail prices the comparison is more striking, and the same holds in feeding :

Alfalfa, 25; corn, 3½, or Kafir-corn, 4.*
Alfalfa, 20; corn, 7, or Kafir-corn, 8.
Alfalfa, 20; corn, 6, or Kafir-corn, 7; oats, 2.
Alfalfa, 20; corn, 4; Kafir-corn, 4.
Alfalfa, 20; fodder corn, 15.
Alfalfa, 20; corn fodder, 8; corn, 4.
Alfalfa, 20; millet, 5; corn, 4.
Alfalfa, 20; sorghum hay, 8; corn, 3.
Alfalfa, 20; prairie hay, 5; Kafir-corn, 5.
Alfalfa, 20; mangels, 20; corn, 5½.

* Kafir-corn in these tables means the grain.

Alfalfa, 20; corn ensilage, 15; Kafir-corn, 5.

Alfalfa, 15; corn fodder, 10; corn, 5; soy-bean meal, 1½.

Alfalfa, 15; millet, 5; Kafir-corn, 7; soy-bean meal, 1.

Alfalfa, 15; sorghum hay, 4; Kafir-corn, 8; soy-bean meal, 1.

Alfalfa, 15; prairie hay, 5; corn, 6; soy-bean meal, 2.

Alfalfa, 15; mangels, 10; corn fodder, 5; Kafir-corn, 3; corn, 3; bran, 2.

Alfalfa, 10; corn fodder, 15; corn, 4½; Old Process linseed-oil meal, 3.

Alfalfa, 10; mangels, 10; corn fodder, 15; Kafir-corn, 3; soy-bean meal, 2; bran, 2.

Alfalfa, 5; ensilage, 40; corn, 3; oats, 3; cottonseed-meal, 1; Old Process linseed-oil meal, 2.

Corn fodder, 20; oats, 4; Kafir-corn, 2; soy-bean meal, 3; bran, 2½; cottonseed-meal, 1.

Corn fodder, 15; millet, 10; corn, 1; Chicago gluten-meal, 3; cottonseed-meal, 2.

Millet, 20; bran, 1; Old Process linseed-oil meal, 2; cottonseed-meal 3.

Sorghum hay, 25; bran, 1½; Chicago gluten-meal, 2; cottonseed-meal, 3.

Prairie hay, 20; Kafir-corn, 3; bran, 2; Chicago gluten-meal, 2; cottonseed-meal, 2.

Timothy, 10; clover, 10; mangels, 10; corn, 3; bran, 3; cottonseed-meal, 2½.

Orchard grass, 10; clover, 10; corn fodder, 10; Chicago gluten-meal, 3; bran, 1; Old Process linseed-oil meal, ½.

ALFALFA HAY FOR FATTENING STEERS

Corn and Kafir-corn are both extremely rich in starch and contain too little protein, the material in

feed necessary for the formation of blood and lean meat. Alfalfa hay is rich in protein and deficient in starch. Either corn or Kafir-corn can be combined with alfalfa hay in such proportions as to make an ideal fattening ration.

There are two systems of feeding alfalfa hay with corn to fattening steers. In one system the steers are fed all the corn they will eat, and then given sufficient alfalfa hay to balance the corn. With this system steers can be induced to eat large quantities of grain and make large gains. George M. Hoffman, of Little River, Kansas, in feeding all the shelled corn and alfalfa hay that his steers would eat, made a gain of five pounds per day per steer for forty-seven days. Mr. Hoffman is one of the extensive cattle-feeders of Kansas and has been in the business for many years. With alfalfa hay and corn he does not calculate on a gain of less than three pounds per steer per day with choice steers.

Another system in fattening steers with corn and alfalfa hay is to feed the steers all the hay they will eat and a limited quantity of corn. This system is especially valuable when the corn crop is short and corn is high. Many feeders report that they have full-fed steers and put them on the market in a well-finished condition, making average gains with one-half the usual quantity of corn.

Alfalfa hay is a laxative, and if steers or any other animals are given all they will eat of it at first serious scouring immediately follows. It pays to get steers on to a full feed of alfalfa hay gradually, taking ten days to two weeks. Professor Cottrell says the best way is to fill the racks with prairie or timothy hay and allow

the steers to eat all they will, beginning with an allowance of two or three pounds of alfalfa hay per day per animal. "Slowly increase the alfalfa, until at the end of two weeks the steers may be allowed to eat all they will. The other hay may then be withdrawn. A limited number of experiments indicate that the best gains may be secured by feeding the hay and grain together. To do this the grain-boxes should be made twice as deep as usual, as seen in Fig. 9. The alfalfa hay should be placed in the bottom of the boxes, the corn thrown on it, and then the hay and corn mixed together. Fed in this way steers seldom get off feed nor are they troubled with scours, and apparently better gains are made for food consumed. At the Kansas Experiment Station, in the winter of 1899–1900, eighty head of steers, fed corn and alfalfa hay in this way, made about two pounds gain per day each, on an average of seventeen pounds of grain per day per steer." A load of feed of alfalfa and corn, weighed up and on the way to the feed-lots, is shown in Fig. 10. This load contains feed for eighty head of steers. In Fig. 11 are seen steers at the Kansas Experiment Station eating chopped alfalfa and corn-meal mixed. These steers made a gain of 2.52 pounds per day for 116 days, requiring only 1,100 pounds of feed for each 100 pounds of increase.

ALFALFA FOR SWINE

The hog is much more of a grass animal by nature than it has, in many cases, any chance to be under domestication. The successful feeder, however, recognizes the fact that the most profitable gains can be made on good pasture with a small allowance of grain

FIG. 9—FEED-BOX, OR TROUGH, AT KANSAS EXPERIMENT STATION

to finish for the market. Clover is a great favorite for hog pastures, but those who have tried both clover and alfalfa find the alfalfa superior. It stands pasturing better than clover, and is a better feed. Alfalfa affords an ideal hog pasture, and if judiciously treated and good hogs are raised there is no part of the farm that will give the satisfaction that the alfalfa pasture does. Pigs weighing thirty to sixty pounds, ten to fifteen head per acre, put on alfalfa pasture in the spring should ordinarily make a gain of one hundred pounds each, but too severe pasturing will destroy the plants. This number will not keep the pasture all eaten down, and it should be mowed occasionally, about the same as for hay. The growth will be fresh after the mowing, and to keep the pasture fresh cut only part of it at a time. This will tend to give rest, as well as to make better feed. Hogs may be left to subsist exclusively on the green alfalfa, but better results are obtained by feeding with it a small quantity of grain. Exceedingly large returns are obtained from the small quantities fed; the alfalfa being green and bulky needs the grain to balance its effect. The pasturage not only affords a cheap growth, but the bulky character expands the digestive tract of the hog, thus enabling it to utilize a large quantity of feed when the finishing period comes, which is a very important consideration. Excellent results may also be obtained by cutting the alfalfa and feeding it green to the hogs, but pasturing is more satisfactory.

The worth of alfalfa for hogs is not confined to its use when green, as the dry hay is very valuable. The Kansas Experiment Station fed fattening hogs grain

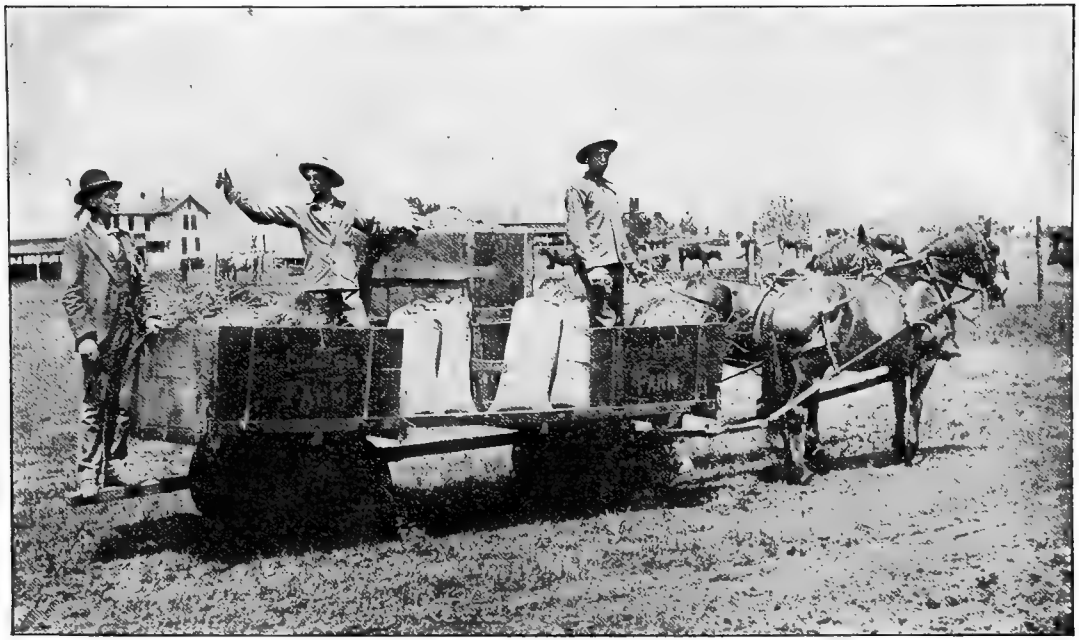

FIG. 10—A LOAD OF ALFALFA AND CORN AT THE KANSAS EXPERIMENT STATION

and dry alfalfa hay just thrown in the pen in forksful as compared with grain alone, and secured 868 pounds of pork per ton of alfalfa hay. The hogs fed grain and alfalfa hay made a gain in nine weeks of 90.9 pounds per head, and the hogs fed grain alone for the same time gained 52.4 pounds per head. A bushel of grain and 7.83 pounds of alfalfa hay produced 10.88 pounds of gain, while a bushel of grain alone produced only 7.48 pounds of gain. Pigs at the experiment station pastured through the summer on alfalfa, after deducting the probable gain due to a small allowance of corn, made a gain of 776 pounds of pork for each acre of pasture. These facts indicate that the most profitable production of pork is possible only when alfalfa is used as a part of the swine ration. It is not impossible that in the near future the hog that eats alfalfa will regulate the price of pork.

Alfalfa may be pastured lightly with hogs the second year after sowing, but it is best to wait until the third year. Under no consideration is it safe to the alfalfa to pasture it the first year. After the plants have obtained root-hold, as they will by the third year, the hogs cannot pull them up, and if given plenty of range and a little grain they will not root to any extent. The alfalfa should be disked and harrowed at least every spring to keep the field smooth. If grass is troublesome, disking any time during the summer will be beneficial.

Alfalfa hay for hogs should be specially cut and cured for this purpose. The hay should contain as large proportion of leaves and as small stems as possible, as hogs do not eat the coarser parts. The last cutting is generally the best for hogs, and should be

FIG. 11—STEERS EATING CHOPPED ALFALFA AND CORN-MEAL MIXED

cut just as the first bloom appears; the stems will then be less woody, and the hogs will like it better. The best care should be taken in curing this hay. The leaves are especially valuable, and should be retained as far as possible. The hay should be stacked or shedded near where the hogs are to be fed during the winter.

The best device for feeding is a flat trough three feet wide and six inches deep, and long enough to accommodate the number of hogs. Throw the alfalfa in this, and the hogs will do the rest; some of the larger stems may be rejected and can be thrown out. The trough saves the leaves which may fall off and will be picked up later. Grinding the hay to a meal and feeding in various ways has been tried, but feeding the whole hay gives the best results.

Alfalfa hay is especially valuable for brood-sows and young pigs. Corn contains too much fat-producing and not enough blood, bone, and muscle-forming material for these classes of hogs; alfalfa contains this growth-producing material in abundance, and is cooling and laxative—the two important qualities in the feed of the brood-sows, especially just previous to farrowing. There is always more or less complaint coming from the strictly corn-growing districts concerning the poor "luck" sows are having with their pigs, but this is not common where alfalfa is made a part of their feed. The reason for the trouble is that a strictly corn diet does not furnish the material for the pigs in the fetal stage. They are starved on corn. Good alfalfa is the cheapest and best preventive of most hog diseases, as it keeps the animals in thrifty condition and thereby less susceptible to disease.

ALFALFA FOR HORSES

Alfalfa is extensively used for horses, both as hay and pasture. The hay alone is too rich a feed for mature horses, and as a consequence there is a great deal of complaint attending its use, especially when the change is first made to alfalfa. The horse that has its feed changed from prairie, timothy, or any other hay, to alfalfa, unless the change is very gradual, becomes the victim of a number of derangements. The rich hay stimulates nearly every physical process, the most noticeable being the urinary and perspiratory glands. The blood may become thickened, and various disorders and complications appear. It is not the alfalfa but the feeding that is at fault. The alfalfa had better be fed to other stock than work-horses, and this is especially true of driving or road horses, although there are many that never have had any other forage. These live and work hard to a good old age, but it takes time to get the digestive apparatus accustomed to so strong a feed. The change must be very gradual, and should be accompanied by a decrease in grain. The older the horses are and the more accustomed they have been to a regular and different diet the more difficult it will be to change. For horses alfalfa hay should be somewhat further advanced at cutting than for other stock. The ripest hay can be fed them to best advantage. For colts or growing horses, where size and strength are sought, alfalfa hay or pasture is especially adapted, as it will produce a strong and vigorous growth. It is especially important that horses receiving alfalfa hay be given plenty of exercise. On the H. D. Watson 2,500-acre alfalfa ranch, near Kearney,

Nebraska, a number of teams were worked for a month in hot weather at draining a swamp, and fed nothing for the entire time but alfalfa hay, with very little loss of flesh. Horses, if not given sufficient range, will gnaw growing alfalfa so close as to kill it out.

ALFALFA FOR SHEEP

Alfalfa holds the same place in the estimation of of sheep-growers who have used it as among cattle and hog raisers. It is, however, used for sheep almost exclusively as hay, as the sheep is extremely susceptible to bloat from eating green alfalfa. Sheep-growers who have alfalfa hay can put lambs on the market in less time and at less cost than with any other forage. J. E. Wing, of Ohio, prefers it to red clover, and says it is almost pitiable to watch the sheep when a change is made even from alfalfa to clover. They will bleat and behave in such a way as to indicate that they consider themselves victims of a very unkind trick. Alfalfa also increases the wool yield. As a rule it is wise to keep sheep away from growing alfalfa.

ALFALFA FOR POULTRY

Alfalfa is becoming very popular as a poultry food, both green and as hay, also as silage, giving variety and succulence, which are always acceptable. The alfalfa is rich in nitrogen, which is necessary for the production of the albumen in eggs and essential to the growth of young fowls. All classes of poultry relish the tender green alfalfa, especially if they are kept in small yards. Alfalfa for winter feed should be the last cutting, which is generally largely leaves with small

stems. The hay should be chopped up in some way. Using a heavy half-barrel with the bottom resting on a solid base and chopping with a sharp spade is a very practical method. Mix from a fourth to a half their bulk with corn-meal or bran, pour hot water over the mass and cover to keep in the steam, and let stand six to ten hours before feeding. The bran is rich in lime, and aids in the production of the egg-shell and the bone of young birds. If bran is used the mixture has a laxative tendency, and perhaps cannot be fed every day. The careful poultry-grower finds in alfalfa a helpful friend.

ALFALFA AS A HONEY PLANT

Alfalfa is the greatest honey plant known to modern agriculture. It is superior to white clover, sweet clover, or buckwheat, and under favorable conditions gives a honey flow from June till October. The farmers in the alfalfa-growing districts are only beginning to appreciate their opportunities for honey production. There were 57,722 stands of bees in Kansas in 1899. The average honey product per stand was given as a little over thirteen pounds for the whole state. Eighteen Eastern counties, where alfalfa is scarcely known, produced only 7.6 pounds of honey per stand. These eighteen counties contained about thirty-eight per cent. of the bees of the state, 21,918 stands, and produced only twenty-two per cent. of the honey. The following table illustrates the value of alfalfa in honey production. The counties selected are the leading honey-producing counties of the state:

HONEY PRODUCTION IN KANSAS ALFALFA COUNTIES COMPARED WITH COUNTIES WHERE LITTLE ALFALFA IS GROWN.

Date.	COUNTY.	*Av. No. pounds per hive.*	*Total yield in pounds.*	*No. acres in alfalfa.*
1897	Douglas	12	15,112	396
1898	Douglas	12 6/7	20,714	604
1899	Douglas	5 1/8	5,576	592
1897	Finney	25 3/4	13,665	11,725
1898	Finney	70	50,535	11,795
1899	Finney	36	20,825	11,541
1897	Leavenworth	12 1/8	11,888	66
1898	Leavenworth	11 5/8	19,588	349
1899	Leavenworth	4 1/8	4,014	218
1897	Washington	30 4/8	42,777	763
1898	Washington	21 3/4	50,389	1,139
1899	Washington	23 9/10	54,531	2,072

Dr. E. C. Franklin and Mr. J. C. Swayze, of the Kansas State University, have made chemical and physical tests of alfalfa honey in comparison with five other common sorts, and alfalfa leads the list in every desirable quality.

In favorable seasons one hundred pounds per hive is no uncommon yield of honey in alfalfa regions. Excessively dry, hot weather, or cool, wet weather, are conditions detrimental to a good yield of honey. Many other flowers do not secrete nectar after being pollinated, but the alfalfa blossom continues to secrete its nectar until beginning to wither.

MAKING A BALANCED RATION

In Press Bulletin No. 12, from the Kansas Experiment Station, the following is given to illustrate somewhat how a balanced ration would differ from others

into which consideration of a proper balance had not entered:

"Many feeders have asked us to explain what a balanced ration is. There are three important groups of substances in feeds—protein, carbohydrates, and fat. Protein includes all materials in feeds which contain nitrogen. It enters into the composition of milk, blood, muscle, hair, and the brain and nerves, and is necessary in the formation of these, and no other substance can take its place. Protein is also used in the body in producing heat, energy, and fat. Carbohydrates include the fiber of feeds, the sugars, starch, and gums, and furnish heat, energy, and fat to the body. The fats in the food produce heat, energy, and fat in the body. Carbohydrates and fat can take each other's places, one pound of fat being worth 2.2 pounds of carbohydrates for production of heat in the body.

"Extended investigations have shown that to obtain the best results feed should be given which will furnish these materials in the following proportions: Dairy cow—protein, 2½ pounds; carbohydrates, 12½ pounds; fat, ½ pound. Fattening steer—protein, 2½ to 3 pounds; carbohydrates, 15 pounds; fat, ½ to ¾ pound. Growing cattle—protein, 4 pounds; carbohydrates, 13½ pounds; fat, 2 pounds; for a young animal, gradually decreasing the proportion of protein until at the age of two years the proportions are similar to those for the fattening steer, but less in quantity. A pig two to three months old needs feeds containing seven and one-half pounds of protein to each thirty pounds of carbohydrates and fat, while a year-old pig needs seven and one-half pounds of protein to each

forty-eight pounds of carbohydrates and fat. Feeds containing a greater proportion of protein than called for by these standards can be fed, because protein can take the place of the other materials. Carbohydrates and fat cannot take the place of protein, however, and no matter in how large quantities they may be fed, if protein is lacking the growth or gain will be reduced.

"The weak point in feeding is that the average rations are greatly deficient in protein, and have too much carbohydrates and fat. Every feeder knows that good pasture produces rapid growth, good gains, and abundant milk yields. It furnishes nutriment in the proportion of three pounds of protein, twelve pounds of carbohydrates, and one-half pound of fat. The proportions in some of our feeds, in pounds per 100 pounds of feed, are as follows:

	Protein.	*Carbohydrates.*	*Fat.*
Corn	7.8	66.7	1.6
Kafir-corn	7.8	57.1	2.7
Prairie hay	3.5	41.8	1.4
Corn fodder	2.0	33.2	0.6
Sorghum hay	2.4	40.6	1.2

"It will be seen that none of these feeds contain a sufficient proportion of protein to secure best results, and all combinations of these feeds will have the same defect.

"Some feeds have too great a proportion of protein to be fed alone, as shown below, the figures indicating pounds per 100 pounds of feed:

	Protein.	*Carbohydrates.*	*Fat.*
Alfalfa hay	10.6	37.3	1.4
Gluten-meal	31.1	43.9	4.8
Linseed-oil meal	28.8	32.8	7.1
Cottonseed-meal	37.0	16.5	12.6
Soy-bean	39.6	22.3	14.4

"Making a balanced ration is combining the feeds deficient in protein with those having an excess of it, to make a ration which will contain the right proportions for the animal fed.

"A balanced ration will produce much better results than the ordinary ration, which is too high in carbohydrates. A cow gave five pounds of butter per week on an ordinary ration, and twelve to fourteen pounds on a balanced ration. Two pounds per day is a good gain for steers on the usual fattening ration. Increasing the protein by substituting four pounds of linseed-oil meal for an equal quantity of corn in the regular ration, a feeder made three to four pounds gain per steer per day. Fattening pigs made a gain of nine and one-half pounds per bushel of Kafir-corn eaten. When one-fifth of the Kafir-corn was taken out and soy-bean meal substituted for it, increasing the protein, a gain of thirteen pounds was made for each bushel of grain eaten."

By referring to the following tables the ration may be computed for any class of animals. The feeding standards are the result of careful investigation, and show the proportions in which the different feed principles should be fed for the best results. The digestible nutrients of a number of the common feeds given in the table on page 68 makes the computation easy, and by studying them the feeder can easily select the feeds best adapted to his particular use:

FEED STUFFS. DIGESTIBLE NUTRIENTS

FEED.	Digestible Nutrients. Pounds per 100 lbs. feed.			Calories in one pound.	Nutritive Ratio. 1:
	Protein.	Carbohydrates.	Fat.		
CONCENTRATES:					
Barley	8.9	64.8	1.6	1438	7.7
Broom-corn seed	7.4	48.3	2.9	1158	7.4
Corn	7.8	66.7	4.3	1567	9.7
Corn-and-cob meal	6.5	56.3	2.9	1290	9.7
Cow-pea	18.3	54 2	1.1	1395	3.1
Cottonseed-meal	37.0	16.5	12.6	1526	1.2
Flaxseed	20.6	17.1	29.0	1925	4.0
Chicago gluten-meal	31.1	43.9	4.8	1598	1.7
Kafir-corn seed	7.8	57.1	2.7	1321	8.1
Linseed-oil meal (old process)	28.8	32.8	7.1	1445	1.7
Linseed-oil meal (new process)	27.9	36.4	2.7	1310	1.5
Millet seed	8.9	45.0	3.2	1038	5.9
Oats	9.3	48.3	4.2	1249	6.2
Rye	9.1	69.7	1.4	1525	8.0
Sorghum seed	7.0	52.1	3.1	1230	8.4
Soy-bean meal	29.6	22.3	14.4	1573	1.8
Wheat	10.2	69.2	1.7	1549	7.2
Wheat bran	12.3	37.1	2.6	1029	3.5
Wheat middlings	12.8	53.2	3.4	1371	4.8
Wheat shorts	12.2	50.0	3.8	1317	4.8
GREEN ROUGHAGE:					
Alfalfa	3.9	12.7	.5	330	3.5
Corn silage (well eared)	1.3	14.0	.7	314	11.9
Fodder corn (with ears)	1.0	11.6	.4	251	12.5
Pasture grasses (mixed)	2.5	10.2	.5	257	4.5
Sorghum fodder	.6	12.2	.4	255	21.8
Soy-bean	29.6	22.3	14.4	1573	1.8
DRY ROUGHAGE:					
Alfalfa hay	10.6	37.3	1.4	948	3.8
Corn fodder (husked)	2.0	33.2	.6	680	17.3
Cow-pea hay	10.8	38.6	1.1	955	3.8
Fodder corn (planted thickly, with ears)	2.5	33.4	1.2	718	14.4
Millet hay	4.5	51.7	1.4	1104	12.2
Oat hay	4.3	46.4	1.5	1106	11.6
Oat straw	1.6	41.6	.7	833	27.0
Orchard-grass hay	4.8	42.0	1.4	930	9.4
Prarie hay	3.5	41.8	1.4	902	12.8
Red-clover hay	6.8	35.4	1.7	857	5.8
Sorghum hay	2.4	40.6	1.2	850	18.0
Soy-bean hay	10.8	38.7	1.5	972	3.9
Timothy hay	2.9	43.7	1.4	926	16.2
Wheat straw	.8	37.9	.5	741	48.8
ROOTS AND TUBERS:					
Mangels	1.0	5.7	.1	129	5.9
Sugar beets	1.1	10.2	.1	214	9.5
Turnips	.8	6.5	.1	140	8.4
MILK:					
Whole milk	3.2	5.0	3.6	304	4.1
Skim-milk	3.9	4.5	.1	160	1.2
Buttermilk	4.0	4.1	.1	155	1.1
Whey	.8	4.7	.3	104	6.7

FEEDING STANDARDS FOR FARM ANIMALS

(WOLFF)

(Per Day per 1000 lbs., Live Weight.)

ANIMALS.	Nutritive (Digestible) Substances.				Nutritive Ratio 1:
	Protein	Carbohydrates.	Fat	Total Calories	
Milch cows	2.5	12.5	0.40	29,588	5.4
Horses lightly worked	1.5	9.5	0.40	22,148	7.0
" moderately worked	1.7	10.4	0.60	25,038	7.0
" heavily worked	2.3	12.5	0.80	30,904	6.0
Fattening steers, 1st period	2.5	15.0	0.50	34,660	6.5
" " 2d "	3.0	14.8	0.70	36,062	5.5
" " 3d "	2.7	14.8	0.60	35,082	6.0
Fattening swine, 1st period	5.0	27.5		60,450	5.5
" " 2d "	4.0	24.0		52,080	6.0
" " 3d "	2.7	17.5		37,572	6.5
Growing Cattle: (Av. live wt. per head.)					
(Age in Mos.)					
2– 3 165 lbs.	4.0	13.8	2.0	41,548	4.7
3– 6 330 "	3.2	13.5	1.0	35.282	5.0
6–12 550 "	2.5	13.5	0.6	32,292	6.0
12–18 770 "	2.0	13.0	0.4	29,588	7.0
18–24 940 "	1.6	12.0	0.3	26,562	8.0
Growing Pigs:					
2– 3 55 "	7.5	30.0		69,750	4.0
3– 5 110 "	5.0	25.0		55,800	5.0
5– 6 137 "	4.3	23.7		52,080	5.5
6– 8 187 "	3.4	20.4		44,262	6.0
8–12 275 "	2.5	16.2		34,782	6.5

MILCH COWS. (Lehmann's Standard.)	Protein	Carbohydrates	Fat	Total Calories	Nutritive Ratio 1:
When yielding daily—					
11.0 lbs. milk	1.6	10.	0.3	22,842	6.7
16.6 lbs. milk	2.0	11.	0.4	25,868	6.0
22.0 lbs. milk	2.5	13.	0.5	30,940	5.7
27.5 lbs. milk	3.3	13.	0.8	33,694	4.5

ALFALFA IN ROTATION

Because alfalfa does not produce a crop generally the first year, and is not at its prime until three years old, it does not appear so well adapted to rotation as some other crops. This is largely because a rotation lasting four or five years does not conform to general experience.

Where alfalfa is allowed to succeed itself year after year, a large proportion of the benefit which might be derived from its power to enrich the soil is lost. Alfalfa itself has little use for the atmospheric nitrogen which it stores in the soil, nor for the surplus of ash elements which it draws from the subsoil, for it can draw more from the same sources as they are needed. Unless alfalfa is soon followed by crops that need and can make use of the fertility which it has rendered available, this fertility is in a considerable measure wasted. The only method of growing alfalfa so that the most benefit may be derived from it is to make it part of a rotation. A non-leguminous crop following a few seasons' growth of alfalfa will make use of the fertility gathered, to the marked profit of the planter.

In Colorado, where alfalfa is grown extensively and as well understood as in any other state, it is common practice of the best farmers to grow it in rotation with other crops. They make it a rule to allow their alfalfa plantings to stand four or five years only, and it may be observed that as a usual thing the farmers who grow alfalfa on the same lands without a change are of the same general class as those who crop their land to wheat successively for a long period of years. Those who have tried it are thoroughly convinced by experience that it pays much better to break

up the alfalfa fields every few years. One of the most extensive and successful growers in Araphoe County was asked: "Can you afford to plow up your alfalfa fields after getting the crops of but three seasons from them? Does not the heavy expense of reseeding, involving the almost total loss of the use of the land for a year, make it necessary that you should allow it to remain in alfalfa longer, to make it profitable?"

The reply was: "We certainly cannot allow alfalfa to stand much longer than three seasons. We must have land on which to sow oats and plant corn and potatoes, and we have found that there is no other half so good as alfalfa sod. It seems almost too bad to plow alfalfa under so soon after it has cost us a year's time to get it established, but it really is the best thing that we can do. We lost perhaps $10 an acre through not having any returns from the land during the season the alfalfa is sown, but the same amount expended in manuring would not benefit succeeding crops nearly so much as growing them on the inverted alfalfa sod, so we feel justified in turning under the alfalfa and seeding other fields."

There is not a crop that will not make good and profitable use of the fertility stored by the alfalfa, providing it is properly managed. It would not be wisdom to turn under alfalfa in September and October and sow at once to wheat, for the ground would be so loose as to dry out rapidly and render the outcome of the crop very problematic, but alfalfa may be turned under in July, after the first crop has been cut, and the land sown to fall wheat at the proper season with a good chance for success. Some of the farmers around Greeley prefer a three-crop rotation—alfalfa, potatoes,

and grain, allowing for each of these occupying one-third of the farm every year; that is to say, the place is given over to these three crops, but they are alternated each year.

The following summary from a bulletin on "Alfalfa as a Fertilizer," by the Wyoming Experiment Station, is suggestive if not conclusive:

"The most important fertilizer, for the arid or semi-arid region, is nitrogen.

"Some plants, of which alfalfa is one, have the power to fix in the soil the free nitrogen of the air. They do this by means of micro-organisms which form bunches or nodules on the roots.

"Therefore, growing alfalfa on the land increases the quantity of nitrogen in the soil and practically solves the fertilizer problem for the West.

"Alfalfa also improves the soil tilth by shading the ground and adding humus by decay of its large, deep-growing roots.

"Growing alfalfa destroys weeds.

"The value of alfalfa harvested from one-half acre of land for five years at Laramie was about $50 more than the cost of producing it.

"The value of potatoes and grain from an adjoining half-acre for five years was about $44 more than the cost of producing at local prices.

"When alfalfa land was plowed and planted to wheat it produced $8 to $12 more value in wheat per acre than the land which had grown potatoes and grain before.

"When alfalfa land was plowed and planted to oats, it produced $16 worth of grain more than land which had grown potatoes and grain before.

"When alfalfa land was plowed and planted to potatoes it had $16 worth more of potatoes per acre than was obtained from land which had grown potatoes and grain before.

"By growing alfalfa, the above increase of yield and values were produced with absolutely no cost for fertilizing the land."

TURKESTAN ALFALFA—A HARDY NEW VARIETY

Within a year or two interest has sprung up in what is claimed as a peculiarly hardy or cold and dry weather-resisting variety of alfalfa from Asia, and known as "Turkestan." Prof. N. E. Hansen, of the South Dakota Experiment Station, who was sent to Asia by the United States Department of Agriculture to investigate this plant, writes of it in March, 1900, thus:

"The usually severe winter of 1898–99 killed off probably half of the alfalfa in Nebraska, Colorado, Wyoming, and many fields in the central prairie states to the eastward were badly damaged, but the Turkestan alfalfa grown in the states mentioned was not affected. At the Wyoming Experiment Station a plat of Turkestan alfalfa was exposed for two weeks without injury to a daily temperature of thirty-five degrees Fahrenheit, the lowest point reached being forty-five degrees. In California it was subjected without damage to a drouth which seriously injured ordinary alfalfa.

"At the experiment station at Brookings, S. D., with a minimum temperature last winter of forty degrees below zero, with the ground bare, the common

alfalfa was killed, while this variety from the heart of Asia came through unharmed.

"One of the main instructions of Secretary Wilson in sending the writer on his trip in 1897–98, of nearly ten months, was to secure, if possible, a hardy drouth-resisting, leguminous forage-plant from the elevated table-lands of Asia. Upon reaching Russia the government agricultural authorities at Moscow and St. Petersburg told me of this plant. It is distinct from common alfalfa, which has come to us largely from Spain. Botanically the difference is expressed by Russian authorities in naming Turkestan alfalfa *Medicago sativa Turkestanica*, while common alfalfa is called *Medicago sativa*.

"Prince Massalaski, of the Department of Agriculture at St. Petersburg, writes: 'Luzerne clover (*Medicago sativa*, var. *Turkestanica*) is the chief forage in use throughout Central Asia, and to the settled population of Turkestan is of the highest importance, since during the summer it forms the chief, and in the winter, prepared in the shape of hay, the only fodder for cattle. It is of all the greater importance because within the region populated by settled inhabitants there are no meadows. Soft herbs and other grasses that grow up in the early spring in certain parts of the steppes are quickly dried up by the hot sun, and give place to coarse prickly stubble, or in any case to less nutritious grasses, that are in general unfitted for sheep, camels, or steppe cattle, and still less fitted for horses or the cattle of those who are settled in the oases, and are thus closely confined to the foreland or rivers, and in most cases are far removed from the steppes.'

"Massalaski describes the native methods of culti-

vation, and continues: 'The native lucerne would seem to be a cattle fodder that cannot be replaced in countries so dry and so hot as Turkestan and the Transcaspian province. Parallel experiments that have been made in the Merv Oases, in the Transcaspian province, in growing French lucerne, under widely different conditions of water supply, have shown that the native lucerne, particularly where there is a lack of water, is vastly superior to the French in the crop it yields, and that it is able to grow satisfactorily with a minimum supply of water—a supply so small that the European (common) lucerne would perish from drouth. This peculiarity of the native lucerne is to be explained by its peculiar formation. It possesses a very large root system, and its leaves are covered with thick down; this, in connection with a deep-cut orifice on the leaf, enables the plant, on the one hand, to imbibe the moisture from the deeper layers of the soil, and on the other hand to exhale it in very small quantity.'

"Along the Volga River, at the dry-region experiment stations of Eastern European Russia, I found this plant doing well, and when I got to the desert and semi-desert regions of Turcomania, Bokara, and the Semiretchinsk provinces of Russian Turkestan, all east of the Caspian Sea, I made a careful study of the plant. Here were camels by the thousand, and clouds of dust often so thick that a wet sponge was found to be essential for relative comfort and breathing. I was so pleased with what I had seen of this plant that I did not stop until fully 18,000 pounds of seed was secured, chiefly from the cotton-growing sections among the Sarts or native Mohammedans.

"The main reason for making the overland journey

of over 2,000 miles (1,300 by wagon, 700 by sleigh) from Tashkent, the capital of Russian Turkestan, to Omsk, in Siberia, via Kuldja, in Western China, was to trace this plant to its northern limits, which we found to be near Kopal, in Siberia (latitude 45° 10′, longitude 79° 10′ east of Greenwich). Kuldja, in Sungaria, Western China, is in latitude 53° 50′, longitude 81° 20′ east, and was the farthest point reached in my journey (about half-way around the globe). Seed was secured from eight different sources, but of course only small lots could be obtained from the places visited in the overland journey. The interesting and to me the most surprising fact is that the alfalfa which proved so hardy at Brookings, S. D., was from the cotton section of Turkestan. So that the plant stands cold as well as drouth. This indicates that in this plant we have an alfalfa that will be hardy to our northern borders, and probably north into Canada."

ALFALFA CULTURE AND INSECT LIFE

PROF. S. J. HUNTER, Entomologist in the Kansas State University, who spent three seasons in the alfalfa fields of western Kansas, making a close study of insects in relation to alfalfa, states his observations and conclusions succinctly to the State Board of Agriculture as follows:

"The peculiar adaptation of the Arkansas valley to the luxuriant growth of the alfalfa plant has caused the conversion of large areas of that fertile region into alfalfa meadows. Wherever we find the natural food-plants of a region so largely supplanted by one form we find there changed conditions and interesting problems, both from the agricultural and the biological standpoint.

"In 1897 letters bearing upon these changed conditions were received, and it seemed highly important that these inquiries should be fully answered. Accordingly, in the fall of 1897 Edwards and Ford counties were visited, and a careful study of the conditions existing there at that season noted. With the encouragement of the farmers of the region, it was decided to begin the following spring a careful study of the relations existing between alfalfa and insect life. These investigations continued throughout that season, and were resumed again this year. The subject-matter of this paper, then, is based upon the practical results of the three seasons' study in this region, together with a survey of territory to be named later.

THE NATIVE GRASSHOPPER

"The fall visit of 1897 revealed the fact that, as had been brought forth by correspondence, there was a species of grasshopper there which at times became of some local economic importance, curtailing the yield of the alfalfa around the borders of the field, sometimes taking an entire field, and frequently being present in numbers sufficient to prevent the formation of seed, yet not in numbers great enough to destroy the forage. It was noticed that these insects deposited their eggs late in the fall, about 100 in a pod, an inch below the surface of the alfalfa meadow. Here these eggs winter. The insects which come from these eggs in the spring are natives of the soil, and appear only upon cultivated lands under given conditions—viz., an undisturbed land for the safe retention of their eggs during the winter, and an early spring food-plant for the nourishment of the young upon their appearance. Wherever these conditions exist this species of grasshopper may be expected to appear in numbers proportionate to the area of the ground furnishing such conditions.

THE ROCKY MOUNTAIN LOCUST

"It may be well at this time, in view of the fact that there is an erroneous idea prevalent that Kansas alone is subject to grasshoppers, to speak of the states comparatively. Since whatever unfavorable comment Kansas may have received has been caused by the presence of the Rocky Mountain locust, I have thought well to present a comparative historical table showing the number of annual visits of grasshoppers to the various states in the Union within the period of 1851

to 1878, the latter being the last year that Kansas was seriously affected by these insects:

NUMBER OF ANNUAL VISITATIONS OF THE ROCKY MOUNTAIN LOCUST DURING THE PERIOD 1851–1878—TWENTY-SEVEN YEARS.

Utah	26	Wyoming	10
Minnesota	18	Missouri	8
Montana	18	Idaho	5
Dakota	17	Indian Territory	5
Texas	15	Nevada	4
Iowa	15	Washington	4
Kansas	14	Oregon	4
Nebraska	13	New Mexico	3
Colorado	12	Arkansas	2

"Kansas is the seventh in the list, and since that date some other states, notably Virginia and Minnesota, have suffered severely from the presence of grasshoppers. Kansas, then, noted for many of its agricultural products, cannot by any means be said to stand first in the production of these insects.

DESTROY THE EGGS

"The grasshopper referred to is not the famous migratory Rocky Mountain locust, but an insect which lives and dies near its birthplace. Since these insects hibernate in the egg stage, endeavor was made to supply the "ounce of prevention." How, then, to destroy these eggs and yet maintain the integrity of the alfalfa plant became the first problem; for, you see, for every grasshopper egg destroyed, not only the subsequent damage caused by the insect after hatching is removed, but the possibility of each of these same insects reproducing another one hundred of its kind is also set

aside. It is frequently supposed that all grasshoppers withdraw to the roadways and places free from trash to deposit their eggs. It is not so with this species, since they lay their eggs right in the alfalfa field, and not infrequently dig the hole right down through the roots of a bunch of grass.

"A study of the alfalfa plant itself became necessary before further procedure. It was found that it secured its water-supply through roots extending some twelve to fourteen feet beneath the surface, and that the crown could be split in several parts and yet the life of the plant go on unimpaired. In the spring of 1898 it was recommended, therefore, to the farmers interested, that they disk their alfalfa meadows as early in the spring as the ground became tillable after the frost, thus breaking up these egg-pods and exposing them to be destroyed by birds, other insects, and climatic influences. This disking many of the farmers feared would destroy the alfalfa itself. One hundred and sixty acres of alfalfa which had been sown two years previously on sod were given for a test. The disk-harrow was run over it in March, and the ground was cross-harrowed with a slant-tooth leveling-harrow. When the work was done the field presented much the appearance of a wheat-field ready for the seed.

"On the 1st of July, 1898, with tent and full laboratory equipments, the writer established a field-station near this experimental quarter-section in order to study the effects of disking upon this alfalfa, and also to observe further the habits of the grasshopper. While suitable quarters could have been secured at farmhouses, it was found more practicable to live right in the meadow, since certain observations upon the

habits of insects required the observer's presence in the early morning and the late evening. And, further, it was found that with the field-station located in this way it was more readily accessible to the farmers in the vicinity. These farmers made frequent visits to our camp, always with inquiries, and with an evident desire to profit by the investigations under way.

THE ALFALFA BENEFITED

"On the 23d of July the first crop of alfalfa upon this experimental quarter-section was cut, and photographs taken, both of the standing forage and of the hay in swath and windrow. The average hight of the stalks was twenty-nine inches, stalks of extreme length being found thirty-three inches. The yield of this first crop was one and one-fourth tons per acre. The grasshoppers had not appeared. Not only had they disappeared, but the native grasses which threatened to reclaim the land were likewise eliminated. Two quarter-sections of alfalfa land not far removed from this spot were rendered practically worthless by the presence of large numbers of grasshoppers throughout the growing season.

"The results thus far, to say the least, were gratifying. The practical benefits derived from this culture, however, were more emphatically expressed upon the appearance of the second crop, which matured, indisturbed by grasshoppers, some ten days earlier than adjoining meadows, and bearing stalks of extreme length of thirty-two inches; average length, twenty-eight inches. The average yield of this crop was one ton per acre. At the close of this season of 1898 I thought it well to have a statement of the comparative

yields from Superintendent Smart, under whose direction this land was disked, and who likewise harvested a large acreage that season. His statement I will give verbatim: 'In regard to the yield of alfalfa on our lands, I will say that the first crop raised on land that was disked was about one and one-fourth tons per acre, and the second crop one ton per acre. We have harvested on our other lands in Edwards and Ford counties, the past year, about 2,500 acres, and the average yield for the first crop was three-fourths ton per acre, and the second crop one-half ton.'

"From this statement it will be readily seen that the disking added one-half ton per acre to each crop. In other words, 160 tons, or eight additional twenty-ton ricks of alfalfa hay, were cut from and stacked upon that quarter-section of Kansas land in the one season because of this cultivation with harrows.

"While the second crop was growing that season I left the field-station in Edwards County and made a cursory survey of the alfalfa-growing districts of Edwards, Ford, Finney, Hamilton, Greeley, Wallace, Logan, Thomas, Sherman, Decatur, and Norton counties, and nowhere under any conditions did I observe such a fine quality of alfalfa as grew that season upon this experimental quarter-section.

CONFIRMED BY FURTHER EXPERIMENTS

"One season's study not being sufficient to thoroughly satisfy us, this method of culture was resumed, and 800 acres were disked in a like manner this spring, giving equally satisfactory results. The yield was not quite so great, owing to the fact that these lands were closely pastured until about the 1st of May, after which

the crop was allowed to grow for hay. The strong, vigorous growth of the plant, however, was noticeable; likewise the almost total absence of grasshoppers and native grasses were points noted by the farmers as they drove over the meadows under experimentation. The 160 acres disked in 1898 were left uncultivated last spring, and the beneficial effects of the previous season's culture appeared again last season, since in both the first and second crops there was a material increase in the yield over that on adjoining lands. In fact, my observations now go to show that in the territory under discussion, where alfalfa is sown upon sod, if this method of culture is not carried on, the native grasses will crowd out the alfalfa and reclaim the soil, whereas, on the contrary, if this method of culture is vigorously prosecuted, a strong, hearty, productive forage plant is the result.

"Plans had been made to conduct experiments upon this method of culture in other parts of the state. In every case the continued wet weather kept the soil in a condition untillable until the alfalfa had grown several inches. Mr. John H. Silsby, of Le Roy, Coffey County, however, by way of experiment, disked five acres when the alfalfa was six inches high, resulting in a noticeable increase in the yield.

EFFECT OF DISKING ON ROOTS AND STEMS

"Getting down to the foundation of the matter, ten roots were dug this season just as they grew in the drill-row in an average place in three fields—and here it might be said that all alfalfa under experimentation was sowed in 1896 upon newly broken sod in the same vicinity, so the conditions of all were as nearly as

possible alike. Ten roots, five of which are shown in Figs. 12, 13, 14, were taken from each of three fields, and a comparative study made of them is best illustrated in tabular form:

	Figures		
	12.	13.	14.
Average thickness of tap-root, inches	9-16	8-16	5-16
Average number of root branches to each tap-root	5.4	5.1	4.2
Average number of stalks to each branch	7	7	4
Average number of forage-raising stalks to each tap-root	37.8	35.7	16.8

KILLS THE CUTWORMS, TOO

"In our field-camp in the summer of 1899 another proposition came before us—viz., the presence of cutworms in the alfalfa. It is known to many who raised alfalfa that season that there was a little, dark-green, striped worm which did considerable damage in some alfalfa fields. This worm likewise spends the winter in chrysalis form, beneath the surface of the ground, and the disk-harrow will destroy it if applied in the early spring, after the frost has left the ground.

ALFALFA HONEY

"In the conduct of these investigations the study of alfalfa as a honey plant and the action of bees thereon have come in for a share of our attention. Apiaries existing under various conditions in the alfalfa region have been visited, and correspondence carried on with leading apiarists from all parts of the state.

"The alfalfa blossom is so constructed that it is impossible for it to fertilize itself; the pollen cannot fall upon the point of fertilization, but must be carried

FIG. 12—SOWED IN 1896; DISKED IN 1898

FIG. 13—SOWED IN 1896; DISKED IN 1899

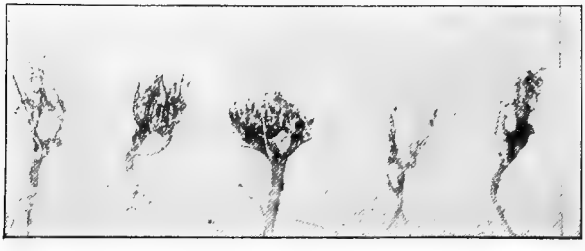

FIG. 14—SOWED IN 1896; NOT DISKED

to that point by some agency. From the shape and size of the alfalfa blossom, it is not probable that cross-fertilization could be safely accomplished by means of currents of air.

"It becomes evident, then, that outside agencies must be called upon, and the plant must provide for these agencies. The agents, in this case, we find to be insects, and the reward offered by the plant for favors rendered is a sweet drop of nectar; that is, the flower, in an enticing way, places a tempting sip of nectar in such a position that when the insect has favored the flower with a few grains of pollen unconsciously brought from an adjoining blossom, and just as unconsciously left, the coveted sip may be enjoyed. It is evident, however, that the first flower visited will not be cross-fertilized.

"A hundred seed pods were gathered from a field twenty-five miles away from any other known colony of bees and another hundred pods from a field less than one-half mile from a large apiary. The pods of these two groups were counted, and it was found that the pods taken near by the bees averaged two-thirds greater number of seeds, and showed seed larger, plumper, and more uniform in size. And while the bees were conducting this valuable seed-making work they were likewise garnering a quality of honey which, submitted to all known chemical tests, has proven itself equal if not superior to any other.

"It has been my observation, further, that alfalfa will yield the greatest quantity of honey under circumstances which tend to give the plant the most vigorous growth. If the plant is upon upland, dry weather will affect the secretion of nectar before it will in a

valley, such as the Arkansas, where the roots of the plants extend to the water. During a dry period bees will fly over other fields in bloom to a field which is irrigated and is beginning to bloom.

"The greatest activity in apiculture in this state is to be found in the alfalfa regions. In the alfalfa-growing portions of the state the average yield per hive in 1898 exceeded sixty pounds, while in portions of the state where alfalfa was not a prominent factor in honey production the bees did well to procure a livelihood for themselves without furnishing a surplus for their owners. Some hives situated in the alfalfa region were able to yield that season a surplus of 200 pounds of comb honey.

"The conclusion of the three years' study of the alfalfa regions of Kansas, then, briefly stated, are that the highest returns from the alfalfa meadow are to be secured by an early spring cultivation of roots with the disk-harrow and a summer visitation of the blossoms by the honey-bee."

DISKING AND HARROWING

PROF. J. G. HANEY, of the Kansas Agricultural College, writing of the use of the disk and harrow on alfalfa, says: "It is demonstrated beyond a doubt that alfalfa must have some cultivation to secure its best development. Statements of what it is possible to do for this plant with the disk or other harrow can scarcely be credited without demonstration. But cultivation with these will make alfalfa succeed in many places where it is now pronounced a failure, and will increase the yields and permanency.

"After the first season's growth the alfalfa has rooted so deeply that it will withstand a surprising amount of surface disturbance. A thorough harrowing with a sharp harrow the spring after seeding, and after each cutting, especially if the surface soil is dry and crusted, will do a surprising amount of good. The harrow will not only destroy much grass and many weeds, but it loosens the surface, makes an earth mulch, and enables the new buds, which produce the new stems and usually come from below the surface, to push out more rapidly and with greater vigor.

"After the Alfalfa is two or three years old the disk-harrow can be used, and the alfalfa should be disked at least each spring just as it starts. Disk both ways with the disks set nearly straight and weighted, and then harrow down smooth. The disk destroys all surface-rooted plants, but does not injure

the deep, sturdy rooting alfalfa. The cutting and splitting of the crowns invigorates the growth and thickens the stand. If crab-grass and foxtail, or any other grasses, tend to spring up after the cuttings, as they will, especially during a dry time, disking and harrowing after cutting will keep the noxious growths back, and enable the alfalfa to make a quicker and more vigorous growth helpful to an increase in yield and in the number of cuttings."

Prof. H. M. Cottrell, of the agricultural experiment station, Manhattan, Kan., writes: "Our first experience in disking alfalfa was in 1898. A field had been seeded to alfalfa in the dry year of 1894 and a poor stand resulted. In 1897 this alfalfa was heavily pastured by hogs. The hogs were taken off early in the fall and a heavy growth of crab-grass came up. The crab-grass was so thick and the stand of alfalfa so thin that it was not worth keeping.

"Late in March, 1898, this field was harrowed with a disk-harrow, the disks sharp and set at as great an angle as possible. It was immediately cross-disked with the disks set the same way. The ground was thoroughly pulverized and the alfalfa apparently destroyed. It soon started, branched out thickly, and we made three good cuttings from the field that summer.

"In 1900 we went a step further in disking alfalfa. The season was very dry at Manhattan, the rainfall in June being 1.19 inches, in July 4.51 inches, and in August 2.84 inches. Two fields of alfalfa, two years old, were disked.

"One field was disked March 28th, the first cutting for hay made May 31st, disked June 6th, the second cutting for hay made June 25th, disked June 27th, the

third cutting of alfalfa made August 13th, and the alfalfa disked for the fourth time August 20th. The last cutting of alfalfa was made September 13th. This shows four diskings and four cuttings of alfalfa on upland in a dry year.

"Another field of alfalfa was disked and cross-disked March 27th. The first cutting of hay was made June 4th, and the second disking June 6th. Through July and the early part of August the alfalfa was cut from day to day and fed green to dairy cows to help out dried-up pastures. August 20th the field was disked, and October 3d the last cutting of alfalfa made.

"The alfalfa in both fields made fine late fall growth and went into the winter in good condition.

"The stand of alfalfa on both fields disked in 1900 was good. A harrow with sharp sixteen-inch disks was used, the disks being set at a slight angle, just sufficient to turn the soil over, and the harrow was weighted to make the disks split the alfalfa crowns to a depth or two inches. The disking split the alfalfa crowns, and this made them throw out many new shoots. The disking made an earth-mulch over the field and prevented the evaporation of water, so rapid in a dry time from an alfalfa field just after being cut. The disks were set so that they barely turned the soil over, and, running at a depth of two inches, they turned the roots of the crab-grass and weeds up to the sun, which killed them. These disked fields were clean and free from crab-grass in the fall.

"We have not disked one-year-old alfalfa. From these experiments we feel safe in recommending disking all alfalfa of two years or more standing. Make the

first disking early in the spring, and then disk immediately after each cutting. If the stand of alfalfa is fair to good, set the disks as we did in the experiments made in 1900. If the stand is poor and the growth of crab-grass thick, set the disks to cut deeply. Disking is of as much value to alfalfa as cultivation is to corn."

ENEMIES AND FRIENDS OF ALFALFA

GOPHERS AND PRAIRIE-DOGS

THE commonest enemies of alfalfa in the Central West are animals and insects. The animals liable to ruin a good stand of alfalfa are gophers and prairie-dogs. The cheapest means of getting rid of them is poison. Take potatoes, peel, and soak them overnight in strong poisonous solutions such as strychnine, arsenic, or corrosive sublimate; drop these potatoes into the holes of burrowing animals. Cover over each hole so treated with a board or a chip, to keep the runway open, and put some earth on top of this. Corn soaked in a solution of lard and strychnine may be used in the same way. Carbon bisulphide has been used with success. It is rather dangerous to handle, as it evaporates very rapidly into an exceedingly poisonous and inflammable gas. If carbon bisulphide is used, keep it in a closed vessel as it is being applied. It can best be applied by soaking corn-cobs in the liquid and dropping these into the burrows. The corn-cobs should be quickly "hooked" out of the liquid with a wire and placed in the burrow, which should immediately be covered with earth, tamped tight, leaving the runways unobstructed. The gas suffocates the animals, and the user must be careful not to get the larger dose himself. Trapping has also been practiced. Where irrigation is available, the best way is to flood the land sufficiently to drown

animals. Care must be taken to draw off the water before it has had time to injure the alfalfa plants.

Prof. J. G. Haney gives the following excellent advice concerning gophers and alfalfa:

"No preventive has been found. Trapping may be employed against them, but it is tedious and generally unsatisfactory. Poisoning is perhaps the easiest and most satisfactory method of destroying gophers, and, if properly done, they may be almost entirely exterminated. To poison them, as soon as a fresh mound is seen, cut potatoes as they are usually cut for seed; then, with a pocket-knife or old case-knife, slit the pieces and drop a crystal of strychnine not larger than a wheat grain in the slit, so it will lodge near the middle of the potato. The potato being moist, the strychnine will soon be dissolved and carried all through it, and it should be used at once. Take a spade and a wagon-rod and proceed at once to the 'gopher patch.' With the rod poke into the ground around the fresh hill until the run is located and open with the spade, drop in a potato, cover up, and proceed to the next hill. Gophers are very fond of potatoes. One dose usually kills; if too much strychnine is used, or the potatoes are not used as soon as prepared, the poison is not so effective. If the field is gone over once a week, the old hills leveled down, and the new ones given a potato, the gopher's work will soon be very much lessened. Now and then one will be too smart for the potato and will keep at work. Try to trap him."

In Bulletin No. 5, Division of Ornithology and Mammalogy, United States Department of Agriculture, is given the following recipe, which reputable persons

who have followed its directions claim is thoroughly effective:

"Put a stick of phosphorus in a five-gallon can with a little cold water; next, pour in hot water, not quite boiling, until the can is half full, and stir with a stick. When the phosphorus is melted, add, while the water is stirred constantly, two pounds of sugar, and immediately after the sugar is dissolved thicken to a stiff batter with corn-meal and flour—half and half; now add wheat, and stir until stiff. While adding the wheat add also fifteen to twenty drops of oil of rhodium. The wheat will soak up all the water in the mass, and it will become quite hard. Keep in a cool place. Small pieces may be chipped off as needed. Gophers may get too little strychnine to kill them, but no matter how small a piece of phosphorous they get it will finally prove fatal. Dig down to an open hole, drop in a small piece, put in a clod to keep the hole from filling, and cover over with loose dirt, to exclude the light."

It is said that using one-fifth the quantity of each ingredient mentioned in this recipe will give as much of the mixture as is likely to be needed at any one time, and the smaller quantity lessens the chances of poisoning animals other than gophers. Phosphorous is one of the deadliest of poisons.

GRASSHOPPERS

The insects that have been most injurious to alfalfa are the various species of grasshoppers. When abundant, they are liable to destroy fall-sown alfalfa. In western Kansas they sometimes destroy the crop intended for seed. Professor Hunter, of Kansas, has shown

that the most effective defense against grasshoppers is the disk-harrow. If the alfalfa fields are disked in the late fall or the early spring the grasshopper eggs are destroyed by being disturbed and exposed to the elements and birds. The disking for this particular purpose should be done when the alfalfa plants are dormant. The grasshoppers that do the greatest harm are not migratory, but breed and pass their existence chiefly in the local alfalfa field. Army-worms have been destructive in a few localities. These and other insect pests which pupate in the ground late in autumn, according to Professor Hunter, are also destroyed by disking.

Poultry in large numbers on the farm are of great service in keeping down the increase of noxious insects. Some farmers have done well by keeping turkeys to free their alfalfa fields from grasshoppers. Turkeys are raised and sometimes rented to farmers to be herded in the alfalfa fields when the 'hoppers are bad, and are found very efficient.

DODDER

The worst parasitic enemy of alfalfa is the dodder or love vine (Fig. 15). Prof. F. H. Hillman's description of the weed is: "The plant is a parasite, incapable of producing its own food, and thus depends for maintenance upon the food elaborated by some other plant. This particular species of dodder, *Cuscuta epithymum*, confines its preference in the main, if not wholly, to the alfalfa plant, which it infests throughout America and Europe. Statements of this species infesting clovers have been seen by the writer, but his own observations in

badly infested fields of mixed alfalfa and red clover have failed to show the infestation of clover by this species of dodder. This particular dodder produces a mass of smooth, reddish-yellow, wiry stems, which encircle the alfalfa stems, where the latter are

FIG. 15—DODDER (*A*) PLANT AND (*B*) FLOWER

pierced by small suckers from the stems of the dodder. These serve to draw the nourishment from the alfalfa, resulting in a short, sickly growth. The alfalfa usually survives, but produces only half a crop or less. With the advance of summer, globular clusters of flowers the size of a pea, light-colored and tinged with purple, are produced along the leafless stems of the dodder. Each flower develops from one to four seeds,

and, as many flowers are produced, the seed production is enormous.

"The seeds are minute, light colored, often tinged with green or purple, globular or irregularly rounded, the surface very finely roughened (Fig. 16). Their form and appearance should permit their easy detection among alfalfa seeds, which are larger (Fig. 17).

"The development of the plant is peculiar. The seeds germinate in the ground, the young stems swing-

FIG. 16—DODDER SEEDS

A, showing a group of seeds, their comparative form and relative size, enlarged. *B*, a group showing the natural size. *C*, the embryo removed from the seed, showing the form it commonly assumes. *D*, a section of a seed, showing the manner in which the embryo lies imbedded in the endosperm.

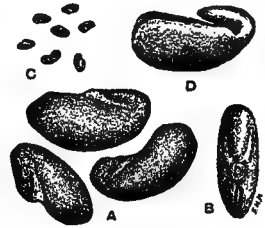

FIG. 17—ALFALFA SEEDS

A, a group showing the side view. *B*, the edge view, with scar. *C*, a group of natural size. *D*, the embryo.

ing from side to side until a stem of the alfalfa is found, about which they at once twine; the roots then die. If no such stem is found the young dodder plant perishes, owing to its inability to take nourishment from soil-food. The plant is an annual, starting anew from the seed each year."

Fig. 18 shows a group of red clover seeds. *A*, side view. *B*, edge view, presenting the scar. *C*, seeds of natural size. Fig. 19 shows white clover seeds. *A*, showing the side-view forms. *B*, edge view, with scar.

C, a group of natural size. *D*, the embryo. These illustrations were prepared with reference to showing the likeness of some of these seeds to those of dodder.

When a field is once thoroughly seeded to dodder, the only remedy is to plow up the alfalfa and cultivate the land a few years to other crops. There are numerous other species of dodder besides the one referred to, but few of them attack alfalfa. If a small patch is discovered, scatter dry straw or hay over the

FIG. 18—RED CLOVER SEEDS

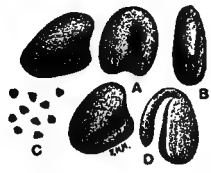

FIG. 19—WHITE CLOVER SEEDS

patch and burn off. The straw scattered thinly destroys the dodder, but will not injure the alfalfa. Burn in a wind, and there is less danger of destroying the alfalfa.

BACTERIA

The alfalfa plant has one parasitic friend that is of the greatest importance to agriculture—namely, the species of bacteria which inhabits the tubercles on the roots of the plants. These microscopic organisms dwell in harmony or symbiosis upon the roots. The bacteria take nitrogen from the air and feed the alfalfa plant, which, in its turn, sends some elaborated food down into the nodules for the maintenance of the bacteria. The activities of the millions of bacteria, which live in symbiosis with every healthy alfalfa plant, enable the alfalfa to add marvelous stores of nitrogen

to the soil at the same time that large quantities are being removed in the hay crops. These bacteria cannot do good work unless the soil is porous and well ærated. The judicious farmer in preparing his soil for alfalfa will provide an open, porous subsoil, in order that the bacteria may have access to large quantities of air from which to draw that most important element of plant-food, nitrogen.

ALFALFA-ROOT ROT

This is a fungus disease which attacks the alfalfa, and from a bulletin of the Texas Experiment Station it appears the same as the cotton-root rot. It is not widely spread and little injury is reported from it. The fungus succumbs to any treatment that destroys ordinary plants, such as salt or kerosene; but the application of these over any extended area would not be practicable. Rotation is practiced in cotton regions to avoid this, and is the only alternative with alfalfa.

A GOOD ALFALFA SHED

"We do not believe a stack was ever built in the United States that did not waste from twelve to twenty per cent. of the hay, and in many cases from twenty-five to thirty," says the editor of the *Iowa Homestead*. "While all this loss is not avoided by sheds, for nothing short of a barn will prevent some exposure, the greater per cent. of the loss will be avoided by the construction of sheds. We have found 26 x 40 and sixteen feet high to be a very convenient size. We have used 6 x 6 and 8 x 8 for the posts, and prefer the

former size. Thirteen feet is sufficient width apart for the posts, and, for a shed of the size mentioned but ten posts will be required. Where pine is used, it is better to get the posts sixteen feet long and bolt them to oak posts set in the ground three or four feet, so that the oak posts, when rotted, can be replaced with new without damage to the shed. These posts can be tied together by four cross-timbers, but the one at the end which the hay goes in should be at least two feet below the top of the posts, so as to allow the horse-fork full of hay full swing in passing in.

"Sixteen-foot boards will roof each side of this shed. They can be battened if necessary, but if the lumber be reasonably dry it will not shrink enough to cause any considerable leaking. It is astonishing how little water flows into these sheds when the roofs are unbattened. We prefer, however, to batten. The horse-fork can be used, the track being suspended from the roof, as in a barn, and the inconvenience of the two inside cross-pieces in a barn of the above size can be avoided by putting the hay in in sections, and taking care not to let quantities of it lie across the cross-pieces. A shed of this kind can be braced without cross-pieces, but not without more or less waste of space.

"Additional expense can be added to this shed profitably. For example, feeding-sheds can be attached on three sides, preferably the north, west, and south. These should be sixteen feet wide, eight feet high at the rear, and with a good slope to the roof, and in this case the main shed should be boarded down to the roof of the feeding-shed. A structure of this kind, with sheds around it, will give 2,200 square feet of shed-room, or the floor space of a barn 40 x 55 feet.

This can be divided into different sections, and the stock fed directly out of the mow into the mangers, thus housing a large number of animals in one place with all the hay under one roof. A crib for corn or a bin for oats can be easily constructed in this shed, so as to have the feed all together. One of the advantages of this shed is the protection it affords against the winter blast, and still another, the fact that if abundance of straw is hauled in for bedding the manure can be kept through the winter, and through the summer if need be, under cover without loss. It is very easy, if a farmer wishes to invest still more money, to make a barn on this general idea, having a large bay in the center, and cattle-stalls and sheds all around it. In fact, with the exception of the octagonal barn, this plan will give more accommodation than any other plan of barn with which we are acquainted."

If hay is well cured before it is put in the mow there is not much need of making special provisions for ventilators. But if the hay season is a rainy one, the grass is often taken from the field before it is thoroughly cured. This, when it is put into large barns, is apt to heat and be much injured. In order to prevent this, ventilators can be constructed in different ways.

An upright ventilator made of four twelve-inch boards set in the middle of the mow floor is good, but in using a hay-fork this is often in the way and inconvenient. These twelve-inch square boxes can be utilized in another way. Make several the length of the mow in which they are placed, and in each bore a number of two-inch auger-holes. Fill in hay to the depth of six or eight feet, then put in another ventilator, and so on.

ALFALFA IN THE DIFFERENT STATES

It is the writer's conviction that no author, however well informed, can possess but a fraction of the knowledge upon a subject widely variant under varying conditions, possessed by the many whose observations have been in the different sections and under the particular conditions which there obtain. With this in mind, and with a desire to be as definite as possible with reference to the success or failure, and growth of alfalfa in the various parts of the United States, effort has been made to secure for this volume from those officially or especially observant of such matters, either directors of experiment stations or extensive practical growers, concise statements of what experience in their states in alfalfa culture has shown or suggested. In the following pages are found presented in substance the observations made by each as to the production, probabilities, and prospects of alfalfa in the regions named:

ARIZONA

Prof. R. H. Forbes, director of the experiment station at Tucson, in reply to the question, "Is alfalfa a success in your territory?" says: "Yes, it does well upon all soils not too alkaline;" but as he speaks from an irrigator's experience there is not a great deal of importance attached to the preparation of the seed-bed. "Seeding is done in the spring in the northern part of the territory. Cutting is done at full bloom seven or eight times a year if irrigated, giving

a yield of one to one and one-fourth tons per acre per cutting, of dry hay, which is preserved in stacks. After being well started it is very enduring and can be successfully pastured. It is not affected by the climatic changes usual elsewhere and grows continuously except during December and January, the weather being too cool at this time. Root-rot causes some, but not serious, loss."

ARKANSAS

Prof. R. L. Bennett, director of the experiment station at Fayetteville, says alfalfa has been sufficiently tried to prove that it will succeed under proper conditions. "The many failures are due to unsuitable soil and improper preparation. With a reasonably fertile, well-drained surface and subsoil, and a well-prepared seed-bed on soil that has grown a crop of cow-peas the season previous, there is a reasonable chance for success. If the soil is extra fertile, sow broadcast; if not so fertile, plant in eighteen-inch rows with drills, in early fall; use twenty pounds of seed per acre in drills and more when broadcasted. If the land is inclined to be foul, cultivate to encourage alfalfa, and discourage weeds and grass when planted in drills. Cut when in good bloom. The number of cuttings and yield depend upon the fertility. The method of curing is the same as with red clover and cow-peas. If rains prevail at the time of cutting, the hay is stored in open frames to cure. Once established on good soil and properly cared for it is permanent, but it has not been thoroughly tested in this state as to its endurance for grazing. Alfalfa resists drouth and is but little affected by extreme wet weather, provided, of course, the subsoil drains rapidly.

It resists moderate cold, but is frequently killed down by sudden changes from warm to very cold weather. Insects, animals, and plant depredators have not been of sufficient importance to receive attention. The bottom-lands are much preferable to the uplands for alfalfa, because of the greater fertility of their subsoil and greater water content."

CALIFORNIA

Henry Miller, writing of the alfalfa-raising operations of his firm—Miller & Lux—in San Mateo County, says in part:

"Since 1871 we have gradually increased our acreage of alfalfa, until we now have about 20,000 acres. This is on reclaimed swamp and upland, under a complete system of irrigation, with the exception of a little light, loamy soil, with water near the surface and no irrigation. On the latter ground the plant is short-lived, on account of the gophers. The depth at which well-water is found varies from ten to forty feet, and, with irrigation, it is immaterial whether the soil is naturally moist or dry. The preparation for seeding consists of deep plowing and cross-plowing, and the depth of planting is not over two or three inches. For light, loamy soils, twelve pounds of seed to the acre is ample, while for hard, rough, new land, from sixteen to twenty pounds is required. Seeding may be done here after the cold season and when danger of heavy frost is past, but in time to take advantage of the spring rains, which are very essential. During the first season the weeds should be mowed as they require it, without regard to returns of alfalfa, and after they are subdued it is well to let the first year's

growth go to seed and allow it to be trampled into the soil by young stock; but if there is a full stand this is not necessary. We irrigate from streams, applying water as soon as the spring opens and every time a crop is cut, the quantity of water needed depending on the quality of the soil. Drainage is very necessary, especially when irrigation is done in warm weather. After the first irrigation, less water is needed at an application than at first. Winter-killing seems to be effectually prevented by watering in the fall.

"Alfalfa will attain its best state in three or four years, and its condition after that will depend upon its treatment. We put stock on our land generally after the first and second growth is cut, and the only rest the land receives is when it is being irrigated. Land in alfalfa for several years we harrow in the spring with a heavy harrow or disk-cutter, and take the opportunity to reseed that which shows lack of vigor. The more sun and the less shade there is the better the growth and the more satisfactory the yield. We find it more difficult to get a stand than to get rid of it; but, in some instances, where we have wanted the land for orchard, vegetables, or root crops, we found several plowings would destroy it. Without irrigation we have not found the crop very profitable, but there are a few favored spots in the state where it can be grown without water; but when we plant we usually select such land as can be put under a perfect system of irrigation before using.

"Longevity of the plant depends on treatment and on the nature of the soil. On heavy 'adobe' soil it will not live and thrive as long as on loamy soil, and on sandy, light soil it will be of short duration with-

out constant and judicious irrigation. After the first season we make two cuttings a year, and consider two tons to the acre each time a good yield. . For hay we cut when the first crop is well advanced—say, nearly in full bloom; the second crop and any later ones are cut when the bloom first shows; otherwise the lower leaves will drop off. The first crop is generally preferable for seed, provided butterflies and other insects have not injured the bloom, as they often do. If the second crop is used for seed, it should ripen longer than the first. The crop for seed is mowed, windrowed as soon as possible, allowed to dry in that state, gathered with a hand-fork, loaded on hay-wagons, and put in stack as gently as possible. We find a good crop of seed a rare thing, but use the ordinary thrashing outfit, and turn out 800 to 1,000 pounds a day; in rare instances double that quantity, with a cost for thrashing and cleaning of about five cents a pound. The hay we never put in barns, but stack in small, narrow ricks, to avoid danger of heating, endeavoring to get it in the ricks as dry as possible, gathering in the forenoon. When we use our own press and men the cost of baling does not exceed $1 per ton. The weight of the bale depends on the kind of press used. An average handy bale weighs about 150 to 175 pounds, and we never have any trouble about the hay keeping perfectly in bales of that size. Like all rank growths, alfalfa will produce double under irrigation, and the quantity will greatly overbalance any possible improvement in quality without irrigation, for I have found little difference in quality between that grown by irrigation and under natural moisture."

COLORADO

Following is the statement of Jacob Downing, of Denver:

"I introduced alfalfa into Colorado in 1862, and have between 500 and 700 acres. It is on upland, clay, sandy, and loam soil, with some 'adobe' subsoil, but mostly sandy loam; it is generally dry to sand rock, and then it is necessary to drill fifty to one hundred feet to get water. After deep plowing and thorough pulverizing, the land should be scraped thoroughly smooth, as this cannot be done after sowing, and is needed to make the mower work smoothly. I sow about twenty-five pounds to the acre, drilling about two inches deep, twelve and one-half pounds each way. Prefer to sow in the spring, early. After the plant is eight inches high it may be cut and used for feed, but is not very good. I have seen near the City of Mexico fields of alfalfa 300 years old that had been constantly cropped and never reseeded. It will last 1,000 years, and possibly forever. I irrigate from streams, whenever desirable; when there is a great deal of heat and wind, probably three times in a season. The water must not be on too long, or the plant will be killed, and the land should be kept as dry as possible during the winter, particularly in cold climates, as on wet soil alfalfa winter-kills. Well-water is better than the stream, provided it is pumped into a reservoir and allowed to get warm. Water is brought from the streams by ditches. Less water will serve the first year than after the plant is matured. I am five miles west of Denver, and 500 feet above the city, in warm valleys. With plenty of water I can obtain three

cuttings a year. Have raised as much as three and one-half tons to the acre at one cutting, and my highest yield of seed per acre has been nine bushels. Hay is cut when the plant is in bloom and cured until dry to the touch of the hand. Stacking by hand makes the best hay, as machinery is likely to pack it in bundles, causing it to heat and become dusty. Hay in the stack costs about $1.50 per ton. Baling costs $2.00 per ton; one-hundred-pound bales are well esteemed, but it is probable that large bales keep better than small ones, if properly cured. Six bushels of seed is a common yield, and the cost of thrashing and cleaning is probably twenty-five cents per bushel. For feeding horses for slow work, the hay is better than clover or timothy. For fattening purposes it is the best in the world, for, while the animal lays on fat, it is never feverish and always healthy. There is no difficulty in ridding land of the plant, as a good team and sharp plow will cut it out without any trouble. I have plowed fields of alfalfa under and put in oats, obtaining three or four times the usual yield, and have known of fifty bushels of wheat produced to the acre on broken alfalfa sod."

DELAWARE

Mr. Herman S. Hazal, of Smyrna, says: "Alfalfa has been given sufficient trial in Delaware by a number of land-owners to prove that it can be grown, and is profitable for hay. I have two acres seeded, thirty pounds to the acre, in the spring of 1898, and cut four times in 1899—May 29, July 12, August 16, September 30—with a total yield of thirteen tons of hay after three days' curing. The first cutting gave six and a

half tons of hay. I have cut it twice already this season (1900), June 5 getting 11,000 pounds, and July 9 getting 6,680 pounds, making a total of eight tons and 1,680 pounds. My ground is partly a side-hill of ordinary land, and I do not think it would grow more than forty bushels of corn to the acre. The alfalfa seems to be very permanent; its greatest plant enemies are sorrel and white clover; no insect enemies have been observed. I am of the opinion that it would be injurious to pasture it in this climate. I cut it when about half in bloom, and value it very highly for all kinds of stock. It sells for $9 per ton. Mr. John P. Hudson, of this town, has been mowing his field for the past fourteen years, and Mr. Wilbur Burmite, of Felton, has been mowing a field for twenty years, and there are many others growing it with success."

GEORGIA

R. J. Redding, director of the experiment station, writes: "Alfalfa is a success in this state, and does best on well-drained, deep, rich, sandy loam, clean of weeds. The land should be deeply plowed and well fined before seeding, and it is best to sow in drills twenty to thirty inches apart, covering the seeds a half inch deep. Sowing is done in September or October, or in February or March, and ten pounds of seed per acre is used. The alfalfa is cultivated shallow three or four times during the season to keep weeds down. It is cut for feed when the blooms commence to appear, and may be mown three to six times a year, yielding three to five tons of green forage per acre at each cutting, varying with the season. The crop is used to

soil-feed horses, mules, and cattle, but is rarely made into hay. Alfalfa is permanent after being well started, but is liable to become infested with weeds unless carefully cultivated; hence sowing in drills is preferred, permitting of the use of a cultivator and hoe. It does not stand pasturing well, for it is understood that the crowns are liable to severe injury from close grazing and tramping. The crop endures drouth well, but growth is much retarded by it. It is not affected injuriously by wet weather or cold, but is killed down by severe freezes when the foliage is of recent growth and tender. It is attacked by dodder and many insects, although none peculiar to the plant, and the injury from these is not serious. It is superior to any of the clovers and equal to vetches, and is considered the best soiling-plant. It is true, however, that perhaps the majority of farmers in Georgia are not even aware that alfalfa is identical with lucerne, and very many of them would not recognize the plant at sight. It furnishes an illustration of the promptness with which Northern and Western farmers take advantage of a 'good thing,' while Southern farmers have been content to grow cotton and corn, potatoes and sugar-cane, and pay very little attention to such valuable plants as lucerne."

IDAHO

William Howard, of Blackfoot, Bingham County, writes: "The two hundred acres of land on which I have grown alfalfa for six years is upland, with sandy loam soil, and subsoil the same, with water at a depth of forty feet, the ground being dry all the way down in summer and fall. The land to be seeded is first

inclosed with levees, the size of each piece to be governed by the 'fall' to the land. Seed may be sown here in the spring or summer, fifteen to twenty pounds to the acre, broadcast, and harrowed in with a light harrow. We have no weeds here, and, in case of early seeding, there will be 1,500 to 2,000 pounds of hay, but no seed, the first year. We irrigate altogether from ditches, applying water three or four times a year; first, as soon as the ground becomes dry in the spring; second, just before cutting the first crop; third, just before cutting the second crop, and sometimes after we cut the third crop. Less water is needed after the first year. The plant does not winter-kill here, and is at its best by the second year, continuing vigorous for at least fifteen years.

"The most essential thing for alfalfa is plenty of water, and, having that, a gravel foundation is far better than one of clay for obtaining large results. There are sometimes two cuttings in a year, and sometimes three, depending on the season, with an average yield each time of two or three tons. Hay is cut when it is in bloom, raked as soon as wilted, and allowed to cure in the cock, then stacked in large stacks with horse-forks. The first crop is best for seed, as it takes nearly a whole season to mature good seed; this is cut and stacked as the hay is, and then thrashed from the stack. The cost of the hay in the stack is $1.00 a ton; of baling, $2.50 a ton; and of thrashing and cleaning, ten bushels out of every one hundred. The price of hay has ranged from $15.00 a ton down to $3.00, with an average for six years of about $6.00, while the price of seed has averaged about $5.00 a bushel. The preferred bale weighs from 100 to 150 pounds. The

average yield of seed is about 500 pounds to the acre. Alfalfa will pasture more animals than will red clover. Every year we pasture about one hundred head of hogs on three acres, fenced in two lots."

ILLINOIS

A. D. Shamel, assistant at the experiment station, Urbana, says: "On the experiment station trial-grounds alfalfa has been tested for the past four years. Last winter all the plants that remained from the previous year's stand were killed by freezing and thawing in February. In other cases where trials of from one-half to five acres were made in different sections of the state, no good stands have been secured. In some cases after three years' growth with constant reseeding a fair stand was obtained, but during the late severe winters all of these fields have been injured, and in most instances the alfalfa has been killed. Further trial with the lately introduced varieties will be necessary before a definite statement can be made as to its success or failure. The chief cause of failure seems to be the nature of the subsoil. In most instances our rich prairie loam is underlaid with a hard clay subsoil, and in some cases the so-called hard-pan. Alfalfa roots refuse to penetrate this stratum of soil, and consequently the plant does not obtain a full root development, so that during the winter a temperature of a few degrees below zero kills the plant. Another factor entering into its introduction is that it requires at least two, and usually three, years to get a stand from which a crop can be cut. The farmer loses three years' cropping from the land, which he cannot afford. The medium red clover can be seeded with oats and

produce a heavy crop the next year. It is also a leguminous crop as well as is alfalfa; its soil-fertilizing ability seems as great, and it fills largely the same place as alfalfa for feeding purposes. So, having other leguminous plants naturally adapted to the soil and climate, the Illinois farmer does not attempt to grow alfalfa. Not only is this true, but alfalfa takes a longer time than clover to cure, and it is almost impossible to get a long enough dry season at harvesting to cure and properly save the alfalfa hay."

IOWA

Prof. C. F. Curtiss, of the Iowa station, at Ames, says: "I do not think alfalfa has been given sufficient trial in this state to fully demonstrate its merits or to determine whether it is a success or failure. We have been growing it in a small way upon the college farm, and it has completely winter-killed twice during the last ten years; but the seasons when it winter-killed were unusually severe, and almost equally fatal to red clover and winter wheat. I do not feel that these failures ought to condemn the alfalfa by any means, and am inclined to think it might be grown here as successfully as in some other localities where it is much more largely used. There is a strongly established disposition, however, in our state to rely on the other clovers, chiefly from the fact that farmers are more familiar with methods of growing them, and the seeding of the land to clover is a simpler process than is securing a stand of alfalfa. We expect to make further investigations."

INDIANA

Prof. W. C. Latta, of the experiment station, Lafayette, says that alfalfa has as yet been tried only in a small way in Indiana; not sufficiently to determine whether it will prove a success or failure. It has grown well in some cases, but as a rule it has not done well, owing to the compact nature of the subsoil. "In places where it has succeeded I think it may be attributed largely to the location and character of the soil that permits the roots to penetrate freely into the deeper subsoil, containing plenty of underlying moisture. Experience leads us to think that the preparation of the seed-bed is also very important, as the young plants are rather feeble the first year and liable to be choked out by the stronger growths. We have usually sown broadcast, in the spring, fifteen to twenty pounds to the acre. We clip at intervals during the first year, the purpose being to hold the stronger growths in check and thus give the alfalfa a better chance. In a few instances we have cut for hay the second time in a season, but in the majority of cases our soil becomes too dry too push up a second crop worth cutting. Our plots have been almost too small to give reliable data as to yield; it has been rather light, however, seldom exceeding one and one-half tons per acre. With our small yields the curing in the ordinary way, by means of the hay-tedder, has not been at all difficult. We have found alfalfa quite permanent when well started. It comes to its best in about three years, and has maintained itself in the sward much longer. On our naturally drained, shallow soil it suffers the most from dry, hot weather. I do not think alfalfa is

damaged by our winters. The only enemy we have observed is dodder, of which we usually get a little in with the alfalfa seed.

"We place a high value upon alfalfa as a feed. One of our highly successful farmers last spring sowed a strip of alfalfa in low-lying peat land. I saw the plants about a month after the seed was sown, and was surprised to note that they were from four to six inches high. I am interested to know if alfalfa will do well in such low-lying soils. Another manager of a large farm proposes to try alfalfa somewhat extensively upon his level low-lying land in northwestern Indiana. Much of it is a peat formation, and the water has not yet been drained down to a very great depth below. I think that alfalfa is suited only to limited areas in Indiana—namely, such soils as are open, have plenty of moisture in the lower soil, and may be left for a number of years for haying and grazing. It has no place in our short rotations, as it is too slow in coming to its prime."

KANSAS

The following is furnished by Prof. H. M. Cottrell, of the State Agricultural College:

"Alfalfa is grown in every county in the state, and at least ninety per cent. of our arable land is suitable for its profitable production. There are only two conditions under which it will not grow: where rock is found within four or five feet of the surface and the soil is dry down to the rock, or where the soil is not drained and is wet a considerable part of the year. In a few of the valleys alfalfa cannot be grown successfully because, while all other conditions are favorable,

the streams overflow and the fields are sometimes covered with water for three or four days in the spring. Such an overflowing usually causes immediate death to the alfalfa. These unfavorable conditions are found on so small an area of land in this state that they are hardly worth considering, but in individual cases are quite serious.

"Good corn ground is good ground for alfalfa. A general rule may be given that it may be grown profitably on any land on which cottonwood trees and corn successfully grow to maturity. It requires a well-drained, thoroughly pulverized soil free from weeds, and the soil should be in good condition with regard to moisture at the time of seeding. Seeding may be done successfully at any time in Kansas between April 1st and September 15th, when these conditions are found. Much of the land in eastern Kansas has been tilled for many years and is weedy. The best success on this usually comes by previously raising a corn crop on the land and keeping it thoroughly cultivated and free from weeds. The following spring an early maturing crop should be planted, such as oats or millet. Harvest this early, immediately plow the ground, and harrow each day the land that has been plowed that day. Then harrow or cultivate the entire field once in ten days until the first soaking rain comes, between August 1st and September 15th. Then seed to alfalfa. Mature alfalfa gets its nitrogen from the air, and is one of our most hardy plants in securing nitrogen. The infant alfalfa plant is one of the weakest grown and is especially feeble in securing nitrogen, and without a liberal supply of this cannot live. The frequent summer tillage advised for pre-

paring the ground kills the weeds and makes available the large supply of nitrogen in just the condition desired by the young alfalfa plant. In western Kansas the land has not been cultivated long and weeds are not so persistent, but often the moisture is deficient. Spring seeding succeeds best under these conditions, because there is then more moisture in the soil.

"We prefer to sow with a press-drill, mixing the seed with an equal part of either bran or coarse corn-chop (meal), drilling half the seed one way and cross-drilling with the other half. We sow twenty to thirty pounds per acre, according to the condition of the land. If seeded in the spring it should be mowed three or four times in the summer to keep the weeds in check, the mower being set high. If seeded in the fall no treatment is necessary, and the following summer a good growth may be expected.

"We cut when, say, one-tenth of the plants have come into blossom. Early cutting insures heavier succeeding crops, and the early cut hay has much more feeding value than that cut when in full bloom or later. Alfalfa may be cut three to four times per year in ordinary seasons. We cut and cure so as to preserve intact on the stems all the leaves possible, the method depending upon the weather.

"Alfalfa from one seeding can usually be expected to endure ten years. In some cases it dies out in three or four years, and in other instances fields fifteen to twenty years old are yielding heavy crops. A reasonable amount of pasturing, such as ordinary grasses will stand, does no injury, but unfortunately in most cases it is excessively overpastured, and seriously injured if not killed. Sheep and horses injure it most.

"Alfalfa is one of the best dry-weather resisters; it stands heat and cold with indifference; also heavy and continuous rains, if on well-drained soil, but in water-soaked land dies from freezing in winter and root-rot in summer. Grasshoppers, webworms, cutworms, gophers, and prairie-dogs are its chief animal enemies. The first two are best destroyed by turkeys; a turkey to the acre will thoroughly rid the alfalfa of these pests, and the turkeys will be profitable besides. Disking in March before the alfalfa has sprouted destroys a large proportion of the grasshopper eggs, and is a check to the cutworms and other insects. Gophers may be destroyed cheaply and quickly by putting strychnine in pieces of freshly cut potatoes and dropping these in the gopher holes. The chief plant enemies are crab-grass and foxtail. Disking early in March, and after each cutting, will do much to overcome these, and at the same time benefit the alfalfa.

"A ton of alfalfa hay properly cured is worth a ton of wheat bran, and the alfalfa can be raised and put in the feed-lot on most Kansas farms at a cost not to exceed $3 per ton. It is necessary, under Kansas conditions, to the cheapest production of beef, pork, milk, mutton, and the growth of young stock. With a good supply of alfalfa any Kansas farmer can combine with it the ordinary feeds grown on his farm, and have balanced rations for all classes of stock without purchasing a pound of mill feed. With all its other good qualities alfalfa is one of the most palatable feeds offered farm animals, and with the exception of causing bloat when used green, is one of the safest."

W. M. Clark, of Saline County, in the central por-

tion of the state, reports something of his operations thus:

"We began sowing alfalfa eight years ago, and now have 265 acres, and intend to put in one hundred acres more next spring. The land is largely 'bottom' and 'second bottom,' and the sandy loam and 'gumbo' produce well if the plants get a good start. If, after seed is sown on the 'gumbo,' a rain falls, it is liable to form a crust that prevents the plants coming through. In digging our wells we find the ground moist, and the water supply in gravel or sand at a depth of sixteen to thirty feet. When the ground is thoroughly pulverized we sow thirty pounds to the acre, and harrow; though if the weather happens to be dry after sowing, better results are obtained by drilling it in as wheat is drilled. We have had the best results from seed sown between the middle of April and the first of May, but good stands have been secured after seeding the first of June, and even the last of August and first of September. Much depends on the weather after sowing. During the first season we mow to keep the weeds down, and I have known seed sown the first of April to yield one and one-fourth tons of hay per acre on 'bottom' land, but we do not cut for seed the first year. For hay we cut when in bloom two or three times, with a yield of about two and one-half tons per acre the first time, one ton the second, and one and one-fourth the third, though on some bottom-land there is not more than one ton per acre for each cutting. The second crop is usually best for seed, though sometimes the first crop is well filled. As soon as the pods are about half colored, the crop should be cut with a binder and dropped off in bunches, not bound. It

cures well in from one-half day to two days. The yield of seed is two to eight bushels, and the cost for thrashing and cleaning, with an alfalfa huller, is about $1.00 per bushel. The ordinary thrashing-machine will not take out all the seed nor clean it ready for market. Compared with timothy or clover, for stock purposes I consider alfalfa hay better, but for driving-horses timothy is preferable, since it is not so much of a laxative. As a pasture crop it is profitable and satisfactory for horses and cattle, away ahead of clover for hogs, and better than red clover for cattle. I consider alfalfa grown without irrigation better than that irrigated, as feed, since there is not so much water in it. That which is ripened and thrashed for seed does not make quite such good hay as does that cut earlier for hay alone, but stock will eat it and do well. In two or three years after seeding alfalfa attains its best yields. Like any other feed-plant, it can be pastured down until killed. Alfalfa is undoubtedly the feed for this section of the country, while it is a most profitable crop for seed at such prices as we have been getting."

A Jewell County alfalfa-grower tells how a seed or hay crop may be successfully harvested and saved, even if but a few inches high, thus: "Take a piece of sheet-iron as long as a sickle-bar and about three feet wide; attach the front edge to the sickle-bar, and turn up the back edge slightly; then the man on the mower carries a rake and shoves off the hay in bunches, in which it is left until put upon the wagon. Alfalfa six inches high can be put up in this way at an expense of less than $1.50 per ton, and makes the very finest hog, cow, and poultry feed, a ton of it being equal to a ton of bran. We suggested this plan to a friend who

had a patch of alfalfa heavily seeded but so short he could not save it. He tried our method, and thrashed sixteen bushels of seed from one load. Another great advantage in gathering a seed crop in this way is that the seed is not shelled and lost in the handling."

LOUISIANA

W. C. Stubbs, of the Louisiana station, says: "Alfalfa has just now quite a boom, a result of experiments made at this station in the last eight or ten years. We estimate that there are at least 10,000 acres of it now growing in Louisiana. Upon the alluvial lands it is a great success; upon the hill lands they are making it a success by artificial methods. The first essential is a rich soil, well drained and brought into a state of high preparation. We sow in October fifteen to twenty pounds an acre, upon well-prepared pulverized soil. It is ready for the first harvest early in March, and upon the alluvial land we cut from five to eight crops a year. It is usually cut when the blooms appear all over the fields. Upon the hill lands we cut from three to six times. We have no trouble in getting the stand. It will last usually from four to six years without diminution, affording from twenty to thirty crops of excellent hay; after this it is thought better to plow up and replant than continue to harvest from a reduced stand. We have never pastured cattle, horses, or sheep upon alfalfa, but have used it very satisfactorily with hogs. One of our large Red River planters reports having raised 3,000 pounds of pork per acre of alfalfa. The weather, if very dry, of course affects it; but with irrigation, which we can practice upon the alluvial lands, it is made to

grow throughout any period of drouth that we may have. It thrives rather better in the spring and fall or winter in this climate than in midsummer with its rains, which usually bring up a large quantity of crabgrass with it. During the winter we cut it generally twice, unless we have an unprecedented freeze. It grows throughout the entire winter, affording two cuttings during the winter season. Last year we had several patches that were overrun temporarily with armyworms, but we soon disposed of them, and since that time they have caused no trouble. Of late a large number of cutworms have appeared in the fields in north Louisiana, and our entomologist, after examination, reported that parasites had begun to attack the worms and that the field would soon be clear. His prediction came true, and we have heard nothing about them since early spring. I see no reason why alfalfa cannot be pastured successfully, but we do not consider it economical to do this, since we can very quickly cut enough for a large stable for one day. Its value is so great that we are selling all the hay that we can make here at the station (and our neighbors are doing the same) at $15 per ton baled. In Shreveport it is worth $11 to $12 per ton."

MAINE

Charles D. Woods, director of the Maine station, says alfalfa is a failure in Maine, as it will not stand the severe winters. It was tried repeatedly fifteen to twenty years ago on all kinds of soil and under all conditions, and he presumes that it has been tried a great many times in late years, but, if so, without success. He says there is no difficulty in making it

grow the first season. The trouble is that it will not survive the winter. "This is apparently not due to the severity of the winter, but to smothering with ice; as in irrigated sections in cold climates a favorite method of destroying alfalfa when they wish to change to other crops is to flood in the fall and allow a coating of ice to form over the tract. These conditions exist practically everywhere in New England. Each year early snows and heavy fall rains leave the ground saturated and more or less completely covered with wet snow. These storms almost invariably clear off cold, and the saturated snow freezes. It is the exception when the fields are not more or less completely covered for several weeks with a layer of ice. Sometimes it is severe enough to cause grass to winter-kill."

As examples of attempts to grow alfalfa in his state, he cites two different conditions: one on a fairly heavy loam and the other on a light sandy soil. In both cases there was no difficulty in making the plants grow fairly well during the first summer, leaving a good covering on the ground for winter protection. On both the heavy and light soil the plants failed to survive the winter with the exception of here and there a single plant.

MARYLAND

Director H. J. Patterson, of the Maryland station, writes: "Alfalfa has not been given a very extensive trial in this state, yet it has been grown to a sufficient extent to prove that it can be grown where proper precautions are taken to obtain a stand. The greatest difficulty our people encounter in growing alfalfa is to get it established. Weeds are very numerous and

persistent in our state, and it is necessary to give several years' preparation to the land before seeding, or else to keep the alfalfa weeded for about the first half of the growing season, or until it gets a fair start. Doing this is expensive.

"It has been started with partial success by seeding with some other crop, such as oats, and cutting about the time the oats headed out, so as not to allow the oats to take the moisture or smother the alfalfa. The soil which seems best suited to alfalfa is well-drained light loam, although we have grown it here on the station farm in a comparatively stiff clay; even in such soil the roots penetrated more than two feet. We generally cut when in full bloom, and the yield has been from a ton to a ton and a half per acre of the air-dried hay. One piece we have was seeded in 1893, cut the first time in 1894, and has been cut from three to four times every season since. We use it green and as hay. In curing we treat it exactly as we do clover. We regard it as having the greatest value for us as a soiling crop, as it gives a large quantity of green feed from a comparatively small area, and is particularly valuable, as it comes very early and also gives us a cutting very late in the season.

"It seems fairly permanent after being well started, but we have experienced trouble in top-dressing it with manure which contained orchard-grass seeds, as these came up and crowded considerable of the alfalfa out. We have not given alfalfa very much of a test in the way of pasturing, but used it one season for ewes with lambs, and it appeared to endure the pasturing very well.

"The only enemy we have had trouble with was

on one piece seeded in very stiff clay ground that was quite wet, and while it made a good start and a good stand, yet, after the first cutting and the second growth started up flourishingly, two or three days of hot, sultry weather brought a blight which killed it off entirely. This only occurred once, about eleven years ago. I would not consider it quite so good as red clover, from the fact that the animals do not seem as fond of it, but other features make it a more desirable soiling crop for us."

MASSACHUSETTS

Prof. W. P. Brooks, of the station at Amherst, writes: "I do not think alfalfa has been tried sufficiently to determine whether it is a success or not. Though results have been discouraging, we are still experimenting. The cause of failure is not in all cases the same, but the following have been observed to exercise a very injurious effect: First, too much water in the subsoil, due to injudicions selection of locality. Second, the severity of our winter and early spring weather without snow. Third, a rust or blight which kills most of the leaves early in summer, making the yield very small and of little value. A soil perfectly drained, with its water-table well below the surface and of a medium texture, gives best results. Before seeding the preceding crops must have left the land free from weeds or weed seeds. The preparation must be as thorough as for any other small crop. Seeding is done in early spring, either broadcast or in drills eight to ten inches apart, using twelve to twenty pounds per acre. Hand-weeding, whether planted broadcast or in

drills, seems to be in most all cases necessary, as the plants grow slowly at first, and in our humid climate with frequent rains would be choked out or greatly weakened by weeds on almost all soils. When sown in drills hand-cultivators have been run between the rows. Cutting is done when in early bloom, and generally not more than two crops per year, as the blight or rust above alluded to checks the growth considerably. It is best cured in cocks and is stored in a barn as other hay.

"It appears to be usually rather short-lived. As so far grown here it commonly loses its vitality to such an extent as to become unprofitable after three or four years. Pasturing has not been tried. Severe cold of winter and early spring at times when we have no rainfall is, I believe, one of the causes which weaken the plant. On suitable soils the climate is seldom either so dry or so wet, and never so hot as to injure well-established alfalfa. Practically the only enemy of importance is the parasitic fungus or rust above alluded to. When this appears it seems to be best to cut the crop at once. Cutting apparently tends to check its increase, and the new growth starts promptly. Alfalfa has not been produced in such quantities as to have established a place for itself in popular estimation, but is known, however, to be a valuable fodder."

MINNESOTA

W. M. Hays, of the station at St. Anthony Park, says alfalfa in Minnesota has generally been a failure. There is one exception, which he notes below. The cause of failure is inability to withstand the severe

winters and to start well when first planted in cold, moist soils, in the springtime. They are finding some hardy varieties, which it is hoped will prove more successful in the future. They have experimented on heavy, medium, and light soils, and on light soils with standing water ten feet below the surface. The seed-bed has been prepared in various ways, generally planted early in the spring, with nurse-crop, without nurse-crop, broadcast, and in drills. It has been cultivated, hand-weeded, and even planted with a sort of listing contrivance. At the experiment station it has generally lived one or two years, then, with an open winter, part or nearly all dies out. A suitable stand to afford a yield has not been secured, with two exceptions. The cutting was done when in early blossom, and two or three light cuttings obtained on those plots which had best withstood the winters. They have not tried pasturing alfalfa; it stands the dry, hot summer, but not wet, cold springs or cold winters. No plant or insect enemies have as yet been encountered, and what experience they had in feeding has been satisfactory. It is believed that alfalfa will yet be found useful in Minnesota, but it must come through finding hardier varieties.

Prof. Thomas Shaw expresses the opinion that past failures do not prove conclusively that alfalfa will not yet be successfully grown in wide areas of Minnesota. "The same want of success followed the first attempt to grow clover. Certain trials have been made near Lake Minnetonka, in which it has been ascertained that alfalfa grown from acclimated seed will succeed much better than that produced by seed grown farther south. This will mean that alfalfa seed should

be sowed where it can be grown for further sowing. In this way the plant will become so acclimated that on suitable soils it may be grown with much regularity and certainty."

MISSISSIPPI

W. L. Hutchinson, director of the Mississippi station, says: "Very little alfalfa has been planted in this state except in this immediate vicinity. Col. W. B. Montgomery, of Starkville, has about 200 acres, which is probably much the largest area found on any one farm in the state. It is planted on second bottom, with an alluvial soil and plenty of lime. It has succeeded as well as could be desired. Wherever the land was thoroughly drained it has done well, at least for a while, but at present we have no alfalfa on the station farm, though we had some twenty-five or thirty acres at one time. I believe about the only thing that interferes with the crop in this state is that in the spring our soil gets very wet—saturated, in fact—and wherever it remains so for a week the alfalfa is killed. Give us deep, thorough drainage, and I have no doubt but alfalfa will do well in all parts of the state. We have a large area of alluvial land between Memphis and Vicksburg, known as the Yazoo-Mississippi Delta, where the soils are from five to forty-five feet deep, and of the very best material, which once was surface soil somewhere. If this land is properly drained for alfalfa it probably would be as widely known for its wonderful productiveness of this crop as it is known for its cotton production. Outside of this section are large areas of creek bottom and valley that are similar in every respect."

The Mississippi Agricultural Experiment Station Bulletin No. 44 says of alfalfa: "We have invariably secured better results from fall than spring seeding. If possible it should be sown in August or September, at the rate of twenty pounds per acre. On account of the long drouths we have had for the past few years it has been very difficult to get the land in the proper condition and the seed sown at the proper time. In the fall of 1896 we could not seed our land until October 31 for the above reason, and as a result of the late planting we got only two cuttings for hay last summer, when we should have had three heavy cuttings and one or two lighter ones, but the pasturage we had from this field compensated in a measure for the small hay yield. This meadow furnished excellent grazing for the dairy cows during November and December. Great care should be taken in turning cattle or sheep on an alfalfa pasture, for the reason that this plant when young and tender, or if wet from rains or heavy dews, will bloat them. It does not bloat horses or hogs, and hogs will keep in good condition on alfalfa pasture with little other feed. When cattle or sheep are to be put on an alfalfa meadow they should be well fed and watered, and allowed to remain on the meadow only a few hours at first. With this precaution, there will be little danger of bloat.

W. B. Montgomery writes that alfalfa is a success on their black, deeply drained limestone soil. "The land should be prepared by deep plowing and thorough pulverization. Sow broadcast or in drills, twenty pounds per acre, in the spring. Use a mower to keep the weeds back, and in a favorable season a light crop of hay may be expected the first year. After being

well started four or five crops each year may be had. Cut when in bloom, rake into windrows when well wilted, cock the following day and leave until fit to put in stacks or barn, which will be only a day or so. Alfalfa is permanent when well started on well-drained land unless pastured by heavy stock in wet weather. It may be pastured by light stock except when very wet. Dry fall seasons make the late cuttings much lighter than the earlier ones. As a food for all kinds of stock it is regarded as having no equal."

MISSOURI

H. J. Waters, dean of the Missouri station, says: "Alfalfa has been tried many years in various portions of this state, and while not fair to say that it will not succeed in special localities, and quite generally along the western border, especially in the northwest, it does not appear from our observations and experience that it will prove a profitable crop in most portions of Missouri. We are not yet satisfied as to the exact cause of this failure; in fact, it may be attributed to a number of causes. On the stiff clay soils the hard-pan is rather too near the surface to allow alfalfa to root deeply enough. On one or two occasions we have had a good stand ruined on such soils by too much rain in early summer. Tile-draining does not seem to remedy this, as we have tested it on a piece of the same kind of land thoroughly drained, with the same results. Again, the alternate freezing and thawing in early spring, especially when the soil is saturated with water, is very injurious. Our people find it difficult to secure a good stand and to follow any practical plan that will hold the weeds in check until the alfalfa

plants have been thoroughly established. This, however, is not an insurmountable difficulty, and would not operate if we were sure of a permanent stand, or a good stand for a number of years after it was once obtained. But for the farmer to be at considerable expense and labor to get a stand that is likely to perish in one or two years, even under the best treatment, does not appear to be profitable. On the station grounds we have cut two good crops and one-half crop per year for two or three years, but have not had what we could call a good stand to last through any long period. As a feed we consider alfalfa hay superior to red clover. It is a source of deep regret that we do not succeed better with it, and we intend to continue our efforts. It is likely that we shall be successful on open sandy soils, but they are usually our best bottom-lands, and could be more profitably kept in corn and wheat; so, for the present at least, such lands will not be generally available for alfalfa."

MONTANA

Prof. S. M. Emery, for many years director of the Montana Experiment Station, writes: "Alfalfa fields in Yellowstone County have been mown for sixteen consecutive years. It has been tested in many of the counties, and under proper selection of soil has usually succeeded remarkably well. When not successful it has usually been where, from irrigation, the water-table has been forced upward or was too near the surface. Alfalfa has succeeded best on second bench-lands—that is, the second rise of land from the ordinary bottom-lands bordering streams. Irrigated lands are desirable, especially in the first years of the plant. Lands un-

derlaid with gravel subsoil are good for alfalfa. Slopes on which the winter snows lie best are good fields. Locations to be avoided are such as hold water too near the surface or on the surface, especially as the ground is freezing in the fall. Preparation should be thorough; alfalfa (to be irrigated) should never be sown until the soil is perfectly mellowed by cultivation, and leveled by cutting off the knolls and ridges and filling the depressions—a bringing up of the surface of the soil to a general plane. This is to facilitate irrigation (and it does not matter if the irrigation be natural or artificial, as the necessity is even greater to distribute rainfall evenly than artificially applied water) and harvesting.

"When one sows an alfalfa meadow it should be remembered that many years are likely to elapse before it is to be plowed up; that twice or thrice each season expensive machinery is likely to traverse it, and that rough land is destructive to all machinery.

"In Montana, under irrigation, I would seed to barley. In Kansas I would have clean, straight alfalfa on the land and no other crop. A 'nurse-crop' is a misnomer; a good nurse does not take the food and drink out of the mouth of the helpless charge, and that is what is done when the so-called 'nurse-crop' is sown with the legumes. On a rich soil, and with irrigation, we get in Montana a fine stand with barley, supplying two irrigations to the growing crop of grain, and follow the harvest, from August 10th to September 1st, with a third irrigation. Thus treated the alfalfa will make a stubble-growth of twelve inches by freezing-up time, and gives fine pasturage. We sow broadcast with a hand-seeder, from May 1st to 15th, fifteen

pounds to the acre, harrow very lightly, across the drill-marks, and, if grain has been sown, with a Scotch harrow. We are indifferent to the effects of late frost upon the young plants. If sown with barley, as stated, we pasture the meadow or grain stubble; if sown by itself and irrigated, we cut two tons to the acre; if in June the field sown with alfalfa alone is weedy, we run a mower over it, with the cutter set low; then irrigate as soon as plants will bear the application of water without the soil baking.

"We begin mowing the first crop as soon as the first few blooms begin to show; in cutting thus early we 'make up on our codfish what we lose on our mackerel,' as the second cutting comes that much earlier. We cut twice, and in the lower valleys three times. The yield is from two to seven tons per acre, depending on age of meadow, stand, water-supply, etc. Five tons would be a fair estimate of the Montana yield. The bulk of alfalfa in Montana is cut under contract. The owners mow the meadow, and contractors take it in the swath and put into stacks for from 75 cents to 90 cents per ton. Hay outfits working on modern lines run three men, five horses, and a hay-stacker, and it is estimated that stacking forty tons is a day's work for such an outfit. About half a ton of hay is brought to the stack out of the swath upon a low-running 'go-devil;' this is so constructed that it is tilted by a system of ropes and pulleys up and onto the stack; very little hand-fork work is done, and the old hay-wagon is relegated to the rear. Mowers begin running as soon as the dew is off, say at 9.30 or 10 A.M. Hay lies in the swath until 2 P.M. if it is clear and dry, as it usually is at haying-time. A two-horse rake

then rakes and roughly cocks it by running lengthwise of the windrows and pulling into bunches. These are left, if the weather is fair, until the next day when the dew is dried off; the stacker, or wagons (where stackers are not employed), are brought into requisition, and the hay stored away or stacked, as the case may be. Whenever smart pressure in wringing a wisp of hay does not bring sap to the outside of the twisted rope of hay it is fit to stack. It lies so loosely that the air will circulate through the common stack, containing eight to ten tons. As soon as the crop is off the ground the meadow is hurriedly irrigated, and in three to four weeks thereafter may be again mowed.

"On lands in which the water-table is from ten to thirty feet below the surface, alfalfa fields seem to be permanent. Great care is exercised to not irrigate in the late fall, especially after August. Alfalfa fields after two to three years old are always pastured in fall and winter, after the hay season is past, mainly by sheep and lambs. I would not keep stock on land after it is thawed out in spring for two reasons: First, the ground would be too soft; second, after the new growth is started it would not be economical to graze at all. Excessive dry weather in the absence of irrigation would be destructive, especially to the young meadows. It is thought that once it is strongly established that it will stand severe drouth, with a diminished yield as the only result. Hot and windy weather is detrimental unless the land be damp from irrigation. Wet weather works no hardships between early spring and August 30th, except as it might retard haying operations. Cold weather does no injury if the plant is well ripened up, especially the crown. With the ground

full of moisture, cold, frosty mornings in October or in April will bark-burst the roots of the alfalfa, as it will apple trees.

"Animal enemies are prairie-dogs, pocket-gophers, and ground-squirrels. These are not likely to injure the alfalfa field except to feed down the tender shoots on irrigated fields, as they are drowned out by water. This is especially true of prairie-dogs and squirrels. Ground-squirrels in fields not irrigated or on knolls above irrigation prey upon the roots, and the mounds thrown up by them dull the sickle-blades and wreck mowers. For all of these pests sulphide of carbon is a sovereign cure. We follow the rodents to their holes, put one-half teaspoonful of the chemical into a dried horse-ball (dung), roll into the hole, and at once close the hole with a shovel of earth. They are quickly suffocated by the fumes arising from the carbon.

"An army cutworm (*Cheriza quotis aquestis*) has been a cause of loss to alfalfa fields in western Montana. Remedies: Where ditches can be filled with irrigating water, plow them deep with sharp banks and fill with water. Large numbers can thus be drowned. In the absence of water cut fresh clover or alfalfa, dip in water containing one pound of Paris green to fifty gallons of water and strew across their path on the plowed field.

"Dodder is an enemy to alfalfa. When found near the infested area, let the hay cure well, and burn on the ground where it grew.

"Alfalfa is a valuable food, depending upon the harvest period and method of curing. If cut just as it begins to bloom, and if it is so handled that the leaves are preserved on the stem, there can be no better forage

crop for fowls, swine, sheep, cattle, and horses. If allowed to stand until the stem has become woody, and is then handled so little reaches the stack except the woody stems, it is a trifle better than hazelbrush and not so good as bright oat straw or wheat hay cut a little green. Alfalfa has great value to all lands predisposed to alkali. This works in a twofold way. If alfalfa can be sown on land prior to the alkali developing to where it encrusts upon the surface it will prevent incrustation or crystalization of the alkali by shading the surface of the ground. Again, alfalfa takes up a large per cent. of alkali into the plant; ten times more alkali salts are present in alfalfa-ash grown on alkali land than is found in plants produced where there is no alkali. Chemical analyses have proved this."

NEBRASKA

Mr. S. P. Baker, of Curtis, Frontier County, in southwestern Nebraska, writes: "Seventeen years ago I heard about alfalfa, and sent to San Francisco for my first seed, which I sowed, ten pounds to the acre, on 'bench'-land; that first field is standing to-day, vigorous as ever. I have eighteen acres that I have had for five years on sandy 'bottom' and dark loam 'second bottom.' The soil is the same to a depth of two to five feet, and bears evidence of being washed from the hills. On the 'table' or 'bench' land water is 160 to 240 feet from the surface, on the 'bottom' thirty two feet, and on 'second bottom' fifty feet. On well-cultivated land deep plowing is sufficient preparation, and seeding may be done as soon as the frost leaves the ground. The best

results are obtained by sowing thirty pounds of seed to the acre, cross-sowing both ways, using a hand-flyer, and putting in a bushel of barley to the acre with it. During the first season the crop should be cut as often as the weeds grow higher than the alfalfa. I have never irrigated. Last year I had three cuttings, averaging six tons to the acre, and I used the fourth crop for hog-feed, with a small quantity of corn, allowing the young pigs to run on it until they were about four months old. The hay is cut when the plants are in full bloom, and it will cure in twenty-four hours of dry, hot weather. I stack it the same as native hay and top it with native hay, as alfalfa does not turn water well. The yield of hay is double that of clover here. The alfalfa has made excellent pasture for all kinds of stock, especially swine, and we think will produce more than any grass or other clover. Some care should be taken in turning on stock-cattle when very hungry, lest they bloat. The native grasses are failing us quite rapidly here, and nothing seems to supply our wants but alfalfa. This year it has been growing steadily, while every other grass, grain, and vegetable has failed, and those neglecting to plant it have discovered their error. Many have had to give up their hogs on account of the hot, dry weather, causing a failure of the corn crop, while, if they had had alfalfa, they could have held the stock over. There is considerable difficulty in ridding land of the plant, but a very strong team can plow it under. It is the best crop to preserve the strength of the land that I have known in my experience."

S. W. Stilgebauer, of Red Willow County, says:

"I have raised alfafa for the past eight years, and find it the most profitable crop that I have ever raised. Last year I cut, for seed, forty acres; had it thrashed, and sold the seed for $1,131.25, and made a good crop of hay after the seed was cut. This year I will cut fifty acres for seed, and it will bring me $1,500. Everything else here is killed by the dry weather, and alfalfa is to us who have it as a bank-account for a dry year."

NEW JERSEY

Edward B. Voorhees, director of the agricultural experiment station, says: "Alfalfa has been given a sufficient trial to determine its success as a green forage and as hay. Success depends more than anything else upon the character of the soil, method of seeding, and treatment of the plant the first year. In ordinarily good seasons here, four cuttings are obtained, the first about the 20th of May. We usually have a dry spell, or it would be possible to get five crops. In 1899 the yield of green forage per acre was 20.2 tons, containing an equivalent in protein of that contained in six tons of average wheat bran. It is valued as a food largely because of its richness in protein, thus enabling the farmer to raise a large proportion of the feed necessary for the dairy. In 1900 the field at the college farm yielded nine tons of green forage at the first cut, and the second cut, just now made into hay, but not hauled and weighed, is estimated to be between one and a half and two tons. Its permanence depends largely upon the thickness of seeding and the start gained the first year. The area now in alfalfa at the college farm is in the third year, and is much better

than any previous year. I can give no positive information as to whether it will endure pasturing here, as I know of no farmers who have used it for that purpose. We have not yet observed that alfalfa has here any insect enemies, although the last growth in September or October is oftentimes checked by a fungus which spots the leaves. This does not seem to injure the growth the next year, hence nothing has yet been done in regard to it."

NEW MEXICO

Prof. Fabian Garcia, of the experiment station of New Mexico, says alfalfa is a success, and the factor which seems to determine its greatest success is the soil rather than location; a deep and rich loamy soil seems best. A very fine seed-bed should be prepared. Drill in the last of January or the first of February, fifteen to twenty pounds to the acre.

"We irrigate to promote germination, and then irrigate again before the first cutting. Usually it is cut when about one foot high, to get rid of the weeds. After this cutting is hauled away the field is irrigated again, and sometimes it is irrigated before being cut the second time. The first year the alfalfa is cut about twice, and sometimes, when all conditions are very favorable for growth, three times. After the first season the cuttings are made when the alfalfa is about in full bloom. The fourth cutting is left until the weather begins to freeze. On an average, alfalfa yields one ton per acre at a cutting. After the alfalfa is cut it is allowed to lie on the ground till the third day, when it is raked, and this is done in the forenoon. If yet too green to stack or bale, it is left in the wind-

row, or it may be cocked and left for a day or more. However, if it is dry enough it is stacked or baled, as the case may be. It is always best to rake in the forenoon, because the leaves stay on better. After being well started alfalfa lives for a long time. There are fields in this vicinity that were seeded fifty years ago, and to-day they are producing as heavy crops as the newer fields. It endures pasturing well if frequently irrigated. Dry and hot weather does not affect it when there is sufficient water to irrigate with. We have but very little wet weather, and it has no noticeable effect on growth. Cold weather stunts the alfalfa very much, especially in the spring, after it has started to grow. Aside from cold spells in the late spring, the cold weather does not injure the alfalfa. So far the alfalfa has no serious enemies. The grasshopper is the only one mentionable for its depredations, and these invaders are infrequent, and nothing is done to check them. Alfalfa is considered the most highly valued and economical forage for the farmers of the territory."

NEW YORK

Alfalfa does not appear to be as yet much of a factor in the agriculture of New York. Prof. I. P. Roberts, of Cornell University, says: "The attempt to raise alfalfa in New York has not always been successful. It seems that in some localities it thrives well; in others it appears to be a failure, and its failure is apparently due to uncongenial conditions of the subsoil. During the last five years many farmers have tried small areas. Some speak very highly of it, others have not been successful. The experiment

station at Geneva has a field of five acres, and they speak highly of it. Heretofore, red clover has been successful, and it has generally been the opinion of the farmers that where red clover would produce two good crops per year, it was not wise to attempt to raise alfalfa. The wheat farmers especially prize the red clover because it prepares the ground so admirably after it is either one or two years old for winter wheat and also corn. Red clover has failed so often within the last few years in this state that many farmers have attempted to substitute alfalfa for it. Many parts of New York, I think, are too cold for alfalfa, and I am sure in many localities the subsoil is not congenial."

M. H. H., Steuben County, N. Y., writes in *Rural New Yorker:* "In the spring of 1899 I sowed one acre of fertile clay loam corn stubble, after an excellent preparation with Clark's cutaway and spring-tooth harrows, sowed to oats, seeding down with one-half bushel of alfalfa and six quarts of timothy. The growth of grass seeding was light at harvest, owing to dry, hot weather, but later rains gave the alfalfa a fine growth ahead of the red clover in the rest of the field, which had been killed considerably, especially after the oats were harvested. I pastured lightly with sheep, and it went into winter with a fine promise of a crop this year. But I was doomed to disappointment: it all lay with its foot-long roots on top of the ground. It could not be the exposed situation, as some sheltered but arid land shared the same fate. It might have been different under a more favorable winter. As a dry-weather plant it proved a grand success, but as a winter plant on our hills it was a dismal failure."

"Alfalfa grows well in the fine alluvial lands of the

broader valleys of Wyoming County," says O. F. Royce, in *American Agriculturist.* "It should be sown in the spring on wheat, the same as red clover, and should be brushed in with a weeder and rolled. After wheat harvest the alfalfa will stool out, and should be cut with a mowing-machine about September 20th. It may be cured for hay or fed green as a soiling crop. It should be cut when in bloom, which in this latitude is about June 20th, August 1st, and September 20th to 25th. With a good stand it will yield three tons per acre at the first cutting, two at the second, and one and one-half at the third. After the third cutting, if the weather be mild, there should be some after-feed for the cows or sheep, letting them on only in the middle of the day when it is dry, and not allowing them to remain too long at first.

"When cutting alfalfa begin at three o'clock in the afternoon, and rake and cock the next day before the dew dries off. Turn once or twice without opening, then open to the air and draw. An alfalfa meadow should last five to ten years, and may be made permanent by proper treatment. Alfalfa is an excellent soiling crop, and, fed with silage, is a good milk producer."

Charles Mills, Onondaga County, N. Y., writes to the editors of *Country Gentleman:*

"The increase of alfalfa has been steadily from the single acre to thousands in the county. It is just becoming the leading forage or hay crop.

"It has been proved it will stand a drouth where everything else fails to give satisfactory crops. Timothy sown with it will yield more timothy hay than when sown alone, and it does not interfere with a

heavy growth of alfalfa. It helps hold up the alfalfa, and aids in curing it, as the timothy dries first. This mixture improves the quality of the hay, especially for horses. In the Syracuse market it is readily bought by the horsemen, and usually brings within one dollar a ton as much as clear timothy.

"I have seen fields this year, during a severe drouth, yield three tons to the acre at the first cutting, and half as much at the second cutting. Instead of cutting the third time, the October and November growth is pastured. It has been found this does no harm, if the ground is firm. The pasturing should not be too close, if it is desired to mow the following year.

"It is a complete exterminator of Canada thistles. In sight of my place is a field, part of which is timothy and clover, which is covered with thistles, while the alfalfa part is clear of them, after cutting for two years.

"The methods of seeding are various. I have seeded with one and a half bushels of oats, using six quarts of alfalfa and four quarts of timothy; harrowed and rolled after seeding. Some seed on winter wheat. If this is done, do not sow as early as is often done with clover, and when sown the ground should be harrowed with a smoothing-harrow. A clean bed is desired. A corn-field or potato ground which has been well tilled makes a desirable seed-bed. It can be sown alone or with a light seeding of oats or barley. The soil should be free from standing water during the winter. It does the best on a soil without hard-pan. It roots deep and will stand a drouth, for the reason that it will find the moisture. If ground is drained with tile

or stone ditches that have a stream of water running in the drains during dry weather, it will fill them with rootlets and clog the drains. I have at a depth of six feet had it shut off a water supply to a water-ram. Had every farm a supply of alfalfa, it would be worth millions of dollars to this country. I have no failures to report."

NORTH CAROLINA

Prof. B. Irby, agriculturist of the agricultural college, writes of alfalfa in North Carolina, saying: "Lucerne does very poorly for this state, generally speaking; but in the stiff red soils in the middle section I have seen a magnificent crop grow on the same land for years in succession, being cut as many as five times in one year, and making a heavy yield of hay besides affording some pasture. On our sandy lands it does practically nothing. I have sown it here on the college farm several times, but have met with little encouragement. I would not recommend it to our farmers generally. No enemies to speak of have been developed here, as very little has been grown."

NORTH DAKOTA

Prof. J. H. Shepperd, of the agricultural college, says: "A number of trials with alfalfa have been made in this state in addition to those made at the station, and we have not heard of any one who has made a pronounced success with it. The difficulty seems to have come from failure to obtain a stand. At the station the failure is attributed to the soil and subsoil being very heavy and difficult to penetrate. Superintendent Hoverstadt, of the Crookston station, put it very well con-

cerning his alfalfa when he said that 'it neither lived nor died'—that is, it lives in little patches and bunches, and never makes a stand and never all kills out."

OHIO

Prof. Charles E. Thorne, director of the station at Wooster, writes: "The results of experiments at this station with alfalfa have been chiefly negative. When we sowed it on the rich bottom-lands of the farm we occupied at Columbus the weeds choked it out, and what has been sown here was on thin soil, with rock but a few feet from the surface, and the growth has been slow and unsatisfactory. I apprehend, however, that the difficulty has been rather in our management than in the nature of the plant, for it has been very successfully grown by Mr. J. E. Wing, of Mechanicsburg, Champaign County, this state, on the deep, gravelly loams of the glacial drift on which he is situated."

Mr. Wing says: "I take pleasure in answering your questions regarding alfalfa, and assure you that it holds its own here as elsewhere as the most valuable crop that can be grown. As to its comparative adaptability, I will say that last season, one of great drouth, we secured a fair stand of alfalfa, while so far as I know not one field of clover made a stand in my neighborhood. Our alfalfa has stood all inclemencies of season, while the meadows of timothy and clover have so deteriorated about me that we have been able to sell alfalfa hay to neighboring farmers at $12 per ton. That would seem a good method of teaching them the value of the plant, but the fact is that very little is being sown, and we stand practically alone in growing it in this part of Ohio.

"Perhaps we have on our farm half of the alfalfa in the state. We sow about twenty-five acres yearly and plow up as much, generally that which has been sown four years. Doubtless we ought not to plow it up. Our land is not yet well enough drained, and corners and strips winter-kill. We find that stock will destroy it if allowed to tramp it in frosty weather, or if they are put on it in sufficient numbers to gnaw it down too close. If a pasture has in it a small area of alfalfa and the rest grass the alfalfa will surely disappear, as the animals will not eat much grass when they can get alfalfa. Yet, a small proportion of grass in an alfalfa pasture is good, as it tends to prevent bloat. We sow *Bromus inermis* as a mixture with alfalfa; the two grow well together, and *Bromus* is a fine pasture grass here on good land. It does not seem to be adapted to poor soils in Ohio. We pasture with sheep, mainly. Last season we lost two per cent.; this season not one thus far. We take them off at 9 A.M., put on again as soon as they want to graze, and they remain all night. Cattle run on it all the time."

OKLAHOMA

John Fields, director of the Oklahoma station at Stillwater, Payne County, says: "Generally speaking, location seems to determine the success or failure. It is difficult to grow alfalfa on extreme upland, while on the bottoms, if not too sandy, it is very profitable. Deep plowing and a thoroughly prepared seed-bed are essential. The land should have been in clean culture crops for one or two years before seeding. The greatest drawback is the crab-grass, which chokes out the alfalfa. We use about twenty pounds of seed per acre,

putting it in with a drill in the spring when the soil is in condition. Web-worms and gophers seem to be the principal enemies. The former are difficult to combat; the latter are easily poisoned. Alfalfa is not generally understood and appreciated. The tendency is to sow, and as soon as it comes up to treat it like a patch of sorghum, and turn hogs on it until they kill it all, and then say, 'Alfalfa has failed.' It would be better if alfalfa in Oklahoma were not pastured at all. While it may be pastured without harm if done intelligently, as a rule we advise against it, for the reason that it is nearly always overdone. Our fields on a medium upland farm are only partially successful. Bunch-grass is making its appearance and seemingly crowding the alfalfa out."

Station Press Bulletin No. 56 says: "Experience with this valuable hay crop has shown that it will thrive in many sections of Oklahoma, and the acreage of it should be increased. A careful survey of the reported failures leads to the conclusion that too close pasturing has been the usual cause. Many fields of alfalfa have been ruined by this method, while fields close at hand that have been cut for hay, and pastured but little, are in excellent condition.

"Alfalfa has a long tap-root, and will not do well on soil with hard-pan close to the surface. It thrives best on soils that have been plowed deep and well cultivated. Early plowing for spring seeding is an advantage, as it gives the soil time to settle and become filled with moisture before sowing. The seed should be sowed as soon as the soil is in good condition in the spring. When the plants are about six inches high they should be cut with a mower set high, and this

operation repeated at intervals of two or three weeks until the weeds are left behind the alfalfa in growth. There are some objections to it, and sometimes sowing late in August has proven better. If wheat ground is plowed early in July, and the weeds are kept down by frequent harrowing, and the seed sown after the soil is filled with moisture, a good stand of alfalfa free from weeds may be secured. Trials of the Turkestan alfalfa imported by the United States Department of Agriculture are being continued by the station.

"Three cuttings of one ton per acre each have been secured on the station farm at Stillwater, and the alfalfa plats at the present time are in good condition."

OREGON

Prof. James Withycombe, agriculturist of the Oregon station, says: "The Cascade range of mountains divides this state into two separate and distinct agricultural sections as far as climate and soil are concerned. In the eastern portion the soil is of volcanic formation, or largely volcanic ash. The climate is dry and semi-arid. Alfalfa with irrigation does remarkably well. There are large areas, however, that will grow alfalfa without irrigation. In western Oregon the soil is mainly alluvial deposits, and the climate is humid, with a precipitation of about forty-four inches annually. Here alfalfa does not succeed or only does so on well-drained land, hence very little is grown. In eastern and southern Oregon alfalfa is sown in the spring after danger from frost is past. The soil is first thoroughly pulverized, and then from ten to twenty pounds of seed is sown per acre, broad-

cast, and harrowed lightly. It is permitted to grow the first season free from molestation in case weeds do not prove troublesome. If they do, a mower, set rather high, is run over the ground as often as necessary to keep the weeds in check. The second season from two to three crops can be cut on irrigated land. Alfalfa should be cut as soon as the blossoms appear, as it develops crude fiber quite rapidly after this stage. It is cured like clover hay, and is equally as susceptible to injury by rain. Alfalfa endures pasturing pretty closely without suffering material injury. On suitable soils it will remain good from ten to twenty years. There are no enemies of consequence. Little difficulty is experienced from pasturing alfalfa here if the precaution is taken to turn the stock in when the plant is free from external moisture and the animals are not hungry. Alfalfa is valued very highly for soiling, silage, hay, or for pasturing. The plant is rich in protein, very palatable to stock, and is easily digested."

PENNSYLVANIA

Prof. G. C. Watson, of the state college, thinks from the number of inquiries recently received pertaining to alfalfa, that it is not well known throughout the state. At the station it has been impossible to secure a good stand, although trials have been made. The alfalfa winter-kills badly the first winter. Limestone clay soil holds too much water, and the plants are injured by freezing. It frequently happens that during the greater part of the winter the ground is covered with snow. Blister-beetles have injured alfalfa, vetches, and some other leguminous crops considerably.

RHODE ISLAND

J. A. Tillinghast, of the experiment station at Kingston, writes: "I think alfalfa has not been tried sufficiently in our state to really determine whether it is a success or failure. In experiments here we have been fairly successful. The soil where grown was a sandy loam. We found that the seed-bed should be deep and thoroughly prepared. We seeded in May, using a drill, and about fifteen pounds of seed to the acre. The first year it was cut but once, at the time of blossoming. The second year we made two cuttings. The yield seemed to be about like the ordinary yield of clover with us, and we handled it and cured it very nearly as we would a clover crop. As to permanence, it seemed to be about the same as our red clover, not winter-killing worse unless in places where water stood and froze, forming ice. We had no trouble with any particular enemies of the plant, with the exception of dodder in small quantities. We did not experiment with alfalfa as a feed, but I am inclined to think where we can raise red clover to advantage I would prefer it as a feed."

SOUTH CAROLINA

J. S. Newman, of the South Carolina Experiment Station, says alfalfa succeeds there on well-drained, fertile soil, with a dry subsoil. The preparation of the seed-bed should be about the same as for turnips. Ten pounds of seed per acre should be sown in drills, so as to permit of cultivation, after each cutting for the first year, especially. Three to six crops per year are harvested, depending on the season, giving an

average of three tons of hay per acre. "Fields twenty-five years old are still in good condition, but continuous pasturing is detrimental, as it prevents branching. Intermittent pasturing is not injurious."

SOUTH DAKOTA

Prof. James H. Shepard, director of the experiment station at Brookings, says: "Alfalfa is not generally grown in this state. There are some portions where irrigation is practiced that are raising fine crops. In the Black Hills I have seen fine fields of irrigated alfalfa, in the valleys, which gave from two to three heavy crops per year. From one and a half to three tons per acre has been obtained at each cutting. The ordinary alfalfa does not seem to do well in the eastern section of the state. The dry, cold weather of winter seems fatal to the roots. We have great hopes, however, of the Turkestan alfalfa, which has given us very good results in small plats, but we have been unable to obtain sufficient seed to make large sowings. The particular enemies of alfalfa are certain leaf-eating insects, like the spotted blister-beetle. These seem to retard the growth by destroying the foliage. With patience we hope to accomplish much in the near future."

TENNESSEE

Andrew M. Soule, of the University of Tennessee, at Knoxville, writes: "Having been in the state only a year, I have not been able to inform myself fully about all the soils and crops, alfalfa being one of the crops. There is a great deal of contradictory evidence concerning its success. I notice a plot on the station

farm that grows vigorously and seems to thrive well on our sandy river-bottom soils. It has been known to make a yield of two to two and one-half tons of cured hay. Of course, we appreciate its feeding value very thoroughly. It is somewhat difficult to establish a stand in this climate, I understand, but there is no reason why it should not succeed well, especially on our 'second bottom' lands, and I have every reason to believe it will. We will commence extensive experiments soon to determine a number of points. On a neighboring farm there is a very healthy, vigorous crop of alfalfa on second bottom-land similar to ours. When it has been tried on the heavy red clay of the state I believe it has failed in some instances. We can, of course, appreciate the reason why. In other instances where it has failed I believe it largely due to a lack of preparation of the soil and seed-bed. Most of the soils of Tennessee have been farmed in a one-crop rotation until all the humus has been exhausted. In many other instances the land has been washed very badly. This has taken all the fiber and life out of it, and the result is there is not sufficient vitality in the soil to produce a good crop of alfalfa. When green crops are plowed under on these lands, as cow-peas, and lime and other fertilizers judiciously used, they produce immense crops, and we think that when they are treated in this way and a fine seed-bed prepared that they will produce magnificent crops of alfalfa. Alfalfa will afford two cuttings easily per year in this section of Tennessee. I do not know of any alfalfa fields being pastured. Our climate might be termed humid through three-fourths of the season. We generally have a drouth through part of July, August,

and September of more or less severity. The rainfall of this section is about fifty-four inches per annum. We do not know that any insect enemies have interfered with alfalfa. About the only animal that does any injury is the mole. The value of alfalfa as a feed is, of course, unquestioned. We fed it as a green soiling crop to our dairy cows with most satisfactory results, and regard it as essential on any dairy farm where intensive methods are followed."

UTAH

Mr. O. F. Hunter, of Salt Lake City, writes: "Alfalfa has done more for Utah than any other crop, being the most profitable that we can raise. I have 160 acres, and twenty years' experience with it. My land is upland loam and gravel soil, very dry from the surface down to water, which is reached at a depth of twenty-five feet. I prefer to seed in April or May, first plowing the ground, sowing oats and harrowing in; then sow the alfalfa seed, roll the ground, and mark it off for irrigating. Twelve pounds of seed to the acre is sufficient. The seed crop is harvested, and after that there will be a light crop of cow-feed from the alfalfa. As soon as the weather is warm in the spring I irrigate from a stream, and after that, when the soil has dried, every ten days, being sure to apply once just before cutting, in order to give the next crop a good start. There is no noticeable difference in the quantity of water needed the first year and any other, only that the more the ground is shaded the longer it takes to dry out. If water is too near the surface of the land, the crop will eventually die out; but it is not liable to winter-kill here. The nearer hard-pan is to

the surface the more water is required, and it sometimes needs to be irrigated every eight days. The plant is at its best, usually, in one year from seeding, and continues vigorous for ten to fifteen years. There are three crops each season, yielding about two and a half tons, two tons, and one ton, respectively. The second cutting is sometimes used for seed, but generally the first. As soon as the pods turn black, and the seed is ripe, it is cut with a common reaper, and thrown aside so that the seed will not be run over. When it is dry, it is thrashed with the ordinary thrashing-machine. The hay is cut as soon as it blooms, and raked while green into small bunches that can be handled in one forkful. It is best stacked with open-sided and shingle or lumber topped sheds. Bales weighing one hundred pounds are preferred for market, and the cost of preparing them is $2.25 a ton. The total cost of alfalfa in the stack, on $30 land, is about $2 per ton. The hay is better for mutton and beef than clover or timothy, but it is not so good for driving-horses. My alfalfa has been used for feeding beef, and I found that I could do as well with it as with hay and corn, and the stock are very fond of it. It is superior for feeding calves and young stock, and we use it, after it is stacked, for feeding swine. The pasturage is better for swine than clover, but it is best to cut it and feed it to them. The hay and water will keep them growing well. The thrashed straw is worth about one-half as much as that cut green for hay alone. There is some difficulty in clearing land of the plant, because the roots are so hard to break up."

VERMONT

J. L. Hills, director of the station, writes: "Alfalfa has hardly been given a sufficient trial to determine absolutely whether it will be a success or failure. About twelve years ago we tried it at some forty-odd places throughout the state with uniform failure. We have tried it several years at Burlington, and have never been able to get a good stand except at the present time, when we have a fairly good stand of about three years' growth. A few weeks ago I visited an excellent field about twenty miles south of Burlington. This was upon a soil very well adapted to it, being old orchard soil well drained. I think the failures have, as a rule, come from poor choice of soil, and more particularly from winter-killing. I am inclined to believe that such success as alfalfa has attained in this state was due largely to character of the soil, to good preparation of the seed-bed, and to careful attention the first year."

WASHINGTON

F. M. Lowden, Walla Walla: "In twenty-two years I have had an experience with from one to four hundred acres of alfalfa, on 'bottom,' 'second bottom,' and up land, with clay, sand, and loam soils, with subsoil of hard-pan and strong alkali from eighteen to twenty inches below the surface, and water at depth of eighteen to twenty feet. The soil is seldom moist all the way down, the dry soil beginning five to eight feet below the surface and ending within two or three feet of the water. After plowing deep and harrowing well, I sow in the spring, late enough to miss frost,

twenty-five to thirty pounds to the acre; then cover in light soil from one to two inches, and in clay soil less. During the first season it should be mowed, so that the weeds cannot choke it out, and then there will be about a ton of hay to the acre to be cut in August. I irrigate with water from streams, thoroughly in the spring and after each cutting, using enough water to to soak the ground for a few days. New land requires more water than old, but the quantity needed is about the same every year. At three years the plant attains its best yields, and with proper care will not need reseeding. There are usually three cuttings each season, with an average of one and one-half tons to the acre, and I have known five cuttings. It is mowed for hay when it commences to bloom, and for seed any time before the frost comes, the second crop being best for the latter use. The seed is mowed, thrashed, and dried as any other clover is. The hay should lie before raking until it is thoroughly wilted, then cure in cock two or three days. We stack in ricks sixteen to eighteen feet wide and any desired hight or length. The hay will not heat if well cured before stacking. On land valued at $40 an acre the cost of hay in the stack is about $1.50, and to bale this costs $2 a ton. The yield of seed is five to ten bushels to the acre, and it sells for $4.50 to $7.50 a bushel, while hay brings $4 per ton. For thrashing, a clover-huller is better than a common machine. The alfalfa straw is of double the value of any other straw for feeding. The hay grown without irrigation is not so rank as that which is watered, and is consequently more valuable as a feed; any is better than timothy, and equal to clover for cattle, but the seed must form in it to make it valuable

for working-horses. After cutting three crops in a season, I usually use the field in the fall for pasturing cattle, and it furnishes nearly double the feed the red clover will, acre for acre. For hogs the pasturage is much better than clover, and I sow with blue-grass and clover on rich ground. For horses and sheep the pasturage is better than clover, but causes bloat in cattle in the same way. It is difficult to plow up alfalfa, but continued cultivation will rid land of it when desired."

WISCONSIN

Prof. S. M. Babcock, assistant director of the station at Madison, says: "We have had little experience with alfalfa at the station, never having more than a small plot at one time. I do not think it is raised as a forage crop in this state—certainly not to any great extent."

WYOMING

B. C. Buffum, vice-director of the experiment station at Laramie, refers to bulletins published by his station which give the magnificent results obtained with alfalfa in that state. "Its points of advantage over other hay crops are, (1), its large yield per acre; (2), its hardiness, after getting started, standing drouth well; (3), its high nutritive value, any kind of stock making flesh and fat upon it without other food, and (4) instead of impoverishing the soil it enriches and leaves it in fine condition for any other crop, as do the clovers and other leguminous plants.

"Alfalfa does well upon almost any land that will produce other crops, providing it is not too wet or

underlaid with a hard or impervious subsoil. Generally it does not do well above 7,000 feet altitude, though in sheltered localities in Carbon County it is reported as thriving at this altitude, and produces two crops. On the Laramie Experiment Farm, situated at about 7,200 feet altitude, it made a good stand and lived through the winter, but the plants did not look thrifty and made little growth. Dodder appeared in the second year and all was plowed up.

"Irrigation seems to be necessary to make alfalfa reach its best development. We cannot recommend it for general cultivation in this state where irrigation cannot be applied, though when once established it takes a great deal of drouth to kill it. It requires considerable moisture to germinate the seeds and keep the plants growing the first year. For hay, twenty or twenty-five pounds of seed to the acre is required, but if planted for the production of seed, half this quantity is sufficient. Sowing oats with the seed is recommended, as they shade and protect the young plants.

"The general rule for harvesting all hay crops is to cut them at the time of blossoming or soon after. It is probable that the time to cut alfalfa to obtain the most nutritious hay is when it is budded and just before blossoming. This was determined by both chemical analysis and feeding experiment at the Colorado station."

M. R. Johnston, superintendent of the Wheatland Experiment Farm, in writing of alfalfa, says: "June 20, 1891, one acre on the experiment farm was planted to alfalfa, twenty-four pounds of seed being used. As the weather was hot and dry the seed did not germinate, and it was irrigated to bring the plants up.

During the season of 1892 there were harvested from this acre seven tons 1,720 pounds, and in 1893 seven tons 1,752 pounds.

"Our experience with alfalfa has demonstrated, I think, that we have a natural home for this plant. For the arid region I believe it is much superior to any other forage plant, being a much more profitable crop to grow on our high land than either the native blue-stem or grama-grass. I do not dispute that the native grasses contain a larger per cent. of nutritious matter, but the superior cropping qualities of the alfalfa is greatly in its favor."

CANADA

Prof. C. A. Zavitz, of the Experimental Department of the Ontario Agricultural College, Guelph, says: "Alfalfa seed has been distributed to farmers throughout Ontario during each of the past ten years. It is found that in some localities and on some farms the alfalfa proves quite successful, while in others it is sometimes a total and sometimes a partial failure. The cause of the failure seems to be poor seed, killing out the first winter, and unfavorable conditions of subsoil. A medium or elevated location appears to be best. The character of the top-soil does not seem to exert as much influence as that of the subsoil; the best results are frequently obtained where the subsoil is a gravelly or sandy loam, and is naturally well underdrained. Alfalfa starts well on land which has had potatoes, corn, roots, or rape the previous year. The land should not be plowed after these crops are harvested, but be thoroughly cultivated. Alfalfa is sown eighteen to twenty pounds per acre, in the fall

and in the spring, with or without grain crops, at each season, but the best results are obtained by sowing in the spring either alone or with a light seeding of grain. About one bushel of barley per acre makes an admirable nurse-crop, and at the same time gives a very good yield of grain. During the first year, if sown alone, a mowing-machine is usually run over to cut the weeds. If sown with grain no special treatment is necessary after the grain is cut. It is advisable, as a rule, not to pasture the first year, although in exceptional circumstances, when the growth is unusually large, it might be pastured to a limited extent. Thorough experiments in determining yield per acre and digestibility by feeding to sheep show that the best results are obtained by cutting when the plants are about one-third in blossom. One lot of alfalfa for five years gave an average of three cuttings per year, there being four cuttings one year, two cuttings another year, and three cuttings in each of the other three years. The average yield was from seventeen to twenty tons of green hay per acre annually.

"In curing great care must be taken not to allow it to lie in the hot sun too long and dry the leaves so that they will fall off. It is permanent after being well started, as farmers have alfalfa that has grown for about twelve years in succession without being reseeded; but it does not seem to endure pasturing very well, as animals eat very close to the crown of the plant. The alfalfa seems to thrive best in warm weather, with frequent showers. Although affected by the hot, dry weather of the summer, it is not as greatly influenced as most other plants with shorter roots. If they have a luxuriant growth early in the

spring, followed by a frost, the plants seem to be injured more than those of red clover or alsike clover. The greatest source of trouble with alfalfa seems to be from crowding by weeds, especially the first year, if sown by itself. Even after it is well established the crop is sometimes pretty badly crowded out by the Candanian blue-grass (*Poa compressa*).

"There is risk when pasturing the crop alone. I have known within fifteen months three instances in which cattle have died while pasturing on alfalfa, and in nearly all cases the animals have been pastured in the same field for some time. When alfalfa is sown with grasses for a permanent pasture there does not seem to be the same danger from pasturing on it."

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